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February 1, 2022

<u>VIA ELECTRONIC FILING</u>

Ms. A. Shonta Dunston
Chief Clerk
North Carolina Utilities Commission
4325 Mail Service Center
Raleigh, North Carolina 27699-4300

**RE: First Stakeholder Meeting Summary Report
Docket No. E-100, Sub 179**

Dear Ms. Dunston:

Duke Energy Carolinas, LLC ("DEC") and Duke Energy Progress, LLC ("DEP" and together with DEC, the "Companies") hereby provide this update to the North Carolina Utilities Commission ("Commission") regarding the Companies' ongoing Carbon Plan stakeholder engagement process as contemplated by Part I, Section 1.(1) of Session Law 2021-165 ("HB 951") and the Commission's November 19, 2021 *Order Requiring Filing of Carbon Plan and Establishing Procedural Deadlines* ("Carbon Plan Procedural Order"). Among other things, the Carbon Plan Procedural Order directs the Companies to conduct at least three stakeholder meetings to gather and incorporate stakeholder input as the Companies develop their initial Carolinas Carbon Plan to be filed with the Commission on May 16, 2022, and to file a report with the Commission within five business days after each stakeholder meeting. On January 25, 2022, the Companies held the first of the three Carbon Plan stakeholder meetings. This first meeting introduced the process and core objectives informing development of the initial Carolinas Carbon Plan, along with providing stakeholders an initial opportunity to learn about the technical inputs and assumptions that will drive the underlying modeling of the Carbon Plan. Approximately 350 external stakeholders attended the session.

As directed by the Carbon Plan Procedural Order, the Companies hereby submit their First Stakeholder Meeting Summary Report ("Summary Report"), which provides an overview of the first Carbon Plan stakeholder meeting and a summary of topics discussed. As previously explained, the Companies have retained Great Plains Institute ("GPI") to serve as the facilitator of the stakeholder process, and GPI prepared the Summary Report for the Companies (included as <u>Attachment 1</u>). In addition to the Summary Report, the Companies are submitting the materials presented to stakeholders (included as <u>Attachment</u>

2). The materials in Attachment 1 and Attachment 2 are also posted on the Companies' dedicated website (www.duke-energy.com/CarolinasCarbonPlan).

As described more fully in GPI's Summary Report, the first stakeholder meeting received substantial participation, and the Companies sincerely appreciate the engaged participation and diverse feedback that was provided during the first stakeholder meeting. To ensure that the stakeholder process reflects the viewpoints of a comprehensive and diverse group of stakeholders, the Companies have undertaken significant efforts to extend invitations to and publicize this first stakeholder meeting, including reaching out to more than 500 known stakeholders. The success of these efforts is reflected in the wide array of participants, ranging from advocacy groups to private business to municipal governments to members of the public across North Carolina and South Carolina. As directed by the Carbon Plan Procedural Order, a list of participating stakeholders is presented on pages 31-38 of the Summary Report.

The Companies look forward to further engagement with interested stakeholders across the Carolinas as these critical issues related to the Companies' system-wide energy transition are considered. The next stakeholder meeting is scheduled for February 23, 2022, which was communicated to meeting attendees at the January 25 meeting. Interested stakeholders may contact GPI at DukeCarbonPlan@gpisd.net to receive future communications about the ongoing stakeholder process.

If you have any questions, please do not hesitate to contact me. Thank you for your attention to this matter.

Sincerely,

Jack E. Jirak

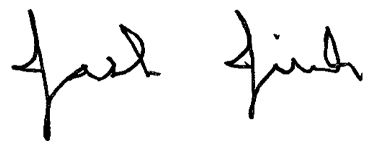
Enclosures

cc: Parties of Record

CERTIFICATE OF SERVICE

I certify that a copy of Duke Energy Carolinas, LLC and Duke Energy Progress, LLC's First Stakeholder Meeting Summary Report, in Docket No. E-100, Sub 179, has been served by electronic mail, hand delivery or by depositing a copy in the United States mail, postage prepaid, to parties of record.

This the 1st day of February, 2022.



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Duke Energy's Carolinas Carbon Plan Stakeholder Meeting Summary Report

Meeting 1 – Level-Setting and Stakeholder Feedback on Modeling Inputs

January 25, 2022 | 9:00 am to 4:00 pm ET

Contents

Meeting Summary

On Tuesday, January 25, 2022, the Great Plains Institute (GPI)[1] convened the first of three stakeholder meetings to inform the development of Duke Energy's Carolinas Carbon Plan. The meeting was held virtually from 9:00am to 4:00pm Eastern. There were approximately 450 individuals who attended the meeting. The full list of attendees is attached to this summary document.

All interested parties were welcome to attend this meeting. To solicit participation, GPI initially sent invitiations to a list of over 500 stakeholders provided by Duke Energy. Recipients were encouraged to pass on the invitation to other stakeholders who they felt may be interested in the process.

Process Employed

PROCESS OBJECTIVES

Overall, this series of three meetings is being designed to meet the following objectives:

1. Ensure the Carolinas Carbon Plan is informed by input from a wide range of stakeholders.
2. Enable a transparent conversation about how to plan an energy transition that prioritizes affordability and reliability for North Carolina and South Carolina customers.
3. Build on areas of agreement, clarify areas of disagreement, and seek opportunities for collaboration in advance of filing the Carolinas Carbon Plan.

MEETING 1 OBJECTVIES AND CONTENT COVERED

Given widespread interest in the Carbon Plan and high expected attendance numbers, this first meeting was designed to establish a baseline of shared knowledge upon which future stakeholder discussions can take place. Specifically, this meeting was designed to accomplish the following objectives:

- Build a shared understanding of Duke Energy's approach to developing the Carbon Plan.
- Identify an initial list of stakeholders' criteria for a successful Carbon Plan, to inform the plan's development.
- Solicit feedback on key modeling inputs and assumptions that need to be finalized immediately to meet the May 16th deadline for the Carbon Plan.

Agenda-wise, this meeting was split into two parts. Part 1 took place in the morning and covered Duke's overall approach to developing the Carbon Plan. It also provided an opportunity for stakeholders to ask clarifying questions and to suggest their criteria for a successful Carbon

[1] GPI has been hired by Duke Energy to serve as a third-party convener and facilitator for the stakeholder engagement process to inform development of the Carbon Plan.

Plan. Part 2 focused on soliciting feedback on key modeling inputs and assumptions that needed to be finalized immediately, in order for the Duke Energy modeling team to begin their work in advance of the May 16th deadline. This portion of the agenda included presentations on modeling assumptions followed by Q&A sessions on each topic. Each major topic from the meeting agenda is listed below with a description of the content covered. Full details for each section are in the meeting notes section of this report.

Part 1: Overview and Key Considerations

1. Welcome and Introductions
    a. Welcome from Duke State Presidents of North Carolina and South Carolina.
    b. Stakeholders were asked to introduce themselves in the meeting chat.
2. Stakeholder Engagement Process and Objectives
    a. Approach and agenda for this meeting.
    b. About the Great Plains Institute.
    c. Objectives and timeline for the overall stakeholder engagement process.
    d. Ground rules to support productive dialogue in these meetings.
    e. Process for accessing meeting materials and providing feedback.
3. Introduction to Resource Planning and Decarbonization in the Carolinas
    a. The three key perspectives of sustainability, affordability, and reliability
    b. Planning for reliability with variable and intermittent generation resources
    c. Overall modeling approach, including looking first at demand, followed by considering what mix of carbon free resources can be deployed over time to meet that demand.
    d. Differences between the execution-focused mid-term plan and the long term plan to reach the 2050 goal.
4. Road to 70% Emissions Reduction and Net-Zero Future
    a. Sources and approach to measuring carbon emissions, both for the baseline and reductions from that baseline.
    b. Resources being considered to provide carbon-free generation while maintaining reliability, including demand-side resources, solar, wind, advanced nuclear, hydrogen, and energy storage.
5. Discussion
    a. Clarifying questions from stakeholders to Duke staff to help build understanding of the content presented so far.
    b. Opportunity for stakeholders to share their criteria for a successful Carbon Plan.

Part 2: Modeling Inputs and Assumptions

6. Introduction to Modeling
    a. How Duke uses capacity expansion and production cost modeling to identify both the resources that would be needed to transition the system and the impacts of those resources on costs.
    b. Key modeling inputs and process steps.

    c. Q&A.
7. Economic Coal Retirements Modeling Methodology
    a. Duke's existing coal fleet.
    b. How Duke conducts coal retirement analysis, and what stakeholder feedback has already been received on that analysis.
    c. Proposed approach to coal retirement analysis for the Carbon Plan.
    d. Q&A.
8. Load Forecast: Key Drivers
    a. Energy efficiency forecasting scenarios and opportunities and strategies to increase deployment of energy efficiency.
    b. Net energy metering (solar) modeling approach, including adoption rate and cost inputs.
    c. Electric vehicle modeling approach and adoption scenarios.
    d. Q&A.
9. Other key modeling assumptions:
    a. Solar interconnection forecast and sensitivities.
    b. Technology forecasts for near-term emerging technologies that Duke believes will be available within the planning horizon.
    c. Natural gas price methodology forecast
    d. Q&A.
10. Next steps
    a. How to access meeting materials and provide ongoing feedback.
    b. Next meeting on February 23rd.

GROUND RULES

To support a constructive meeting environment, GPI established and asked all attendees and panelists to agree to the following ground rules for this and future meetings:

- **Respect each other**: Help us to collectively uphold respect for each other's experiences and opinions, even in difficult conversations. We need everyone's wisdom to achieve better understanding and develop robust solutions.
- **Focus on values and outcomes**: Today's discussion is about what stakeholders value in the energy future, and how the Carolinas Carbon Plan can align with those values. Pending legal issues are outside the scope of this conversation.
- **Chatham House Rule**: Empower others to voice their perspective by respecting the "Chatham House Rule;" you are welcome to share information discussed, but not a participant's identity or affiliation (including unapproved recording of this session).
- **Respect the time**: Our time together is limited and valuable, and we have a large group, so please be mindful of the time and of others' opportunity to participate.
- **Use the chat:** Please submit your comments and questions in the chat. GPI staff will monitor the chat to pull out questions for Q&A portions. Please be respectful and focus on issues, not people.
- **Raise your hand**: During dedicated Q&A portions of the meeting, use the "Raise Hand" feature to indicate you would like to voice a question or comment.

MEETING LOGISTICS AND PARTICIPANT INTERACTION

The meeting was held via Zoom Webinar. Stakeholders were allowed to freely chat one another and speakers and facilitators. They were also allowed to raise their hand to be unmuted and ask questions or provide their thoughts orally during Q&A and discussion portions of the meeting. Staff from GPI facilitated the meeting and took meeting notes, which are included in this summary. During the 11:00am discussion portion of the meeting, GPI staff took notes live on-screen to ensure accuracy in capturing stakeholder comments. In keeping with the ground rules detailed above, the meeting notes have been anonymized. GPI has also made available an anonymized printout of the meeting chat on the Carbon Plan webpage.[2] The meeting was recorded for the purpose of sharing the presentations, however in keeping with the ground rules, the Q&A and discussion portions of the recording will not be shared.

Identifying Points of Consensus

Given the large audience of stakeholders who had registered for this meeting, it was not designed to drive towards consensus. Instead, facilitators sought to provide the opportunity for stakeholders to express their thoughts through the chat and orally during the Q&A and discussion portions of the meetings. All comments and questions have been recorded so that Duke Energy can consider them in developing the Carbon Plan. In addition, the comments and questions recorded during this meeting will be used in the following ways to support this process:

- GPI will develop a summarized list of stakeholder criteria for a successful Carbon Plan, which will be sent back out to stakeholders for review and refinement.
- Comments from the chat and discussion portions of meeting will be organized into a list of themes for stakeholders to review and refine.
- The themes identified from this meeting will inform the design of future meetings agendas, including consideration of forming smaller topical subgroups that work towards consensus on key issues.

Accessing Meeting Materials

All meeting materials, including the agenda, slide decks, recordings of the presentations, an anonymized printout of the meeting chat, and notes will be posted on the Carbon Plan website at www.duke-energy.com/CarolinasCarbonPlan.

In addition, stakeholders are encouraged to send additional feedback and comments to inform the development of the Carbon Plan to DukeCarbonPlan@gpisd.net.

2 www.duke-energy.com/CarolinasCarbonPlan

Meeting Notes

I. Process Overview

Doug Scott, Great Plains Institute

1. Today's approach
    a. Today will be more presentation heavy than future meetings as one of the goals is level-setting. Attendees will have the opportunity to weigh in by chat and verbally during Q&A and discussion portions of the agenda.
    b. The goal is to hear form a wide range of stakeholders, regardless of their level of expertise and knowledge on the issues. Today's meeting is intended to help folks get up to speed on the issues.
    c. The first half of today will be an overview and level setting on key considerations
    d. The goal of today's meeting is to provide a lot of information to attendees, and to hear from attendees about their questions, thoughts, and concerns to inform the development of the Carbon Plan and the design of future meeting agendas.
    e. Attendees should feel free to extend the invites to this process to others who should be engaged.
2. About Great Plains Institute (GPI)
    a. Our job in this project to facilitate stakeholder engagement and produce reports that summarize what was discussed at these meetings.
    b. GPI is a 25-year old nonprofit organization based in Minneapolis. Our main goal is decarbonization, and our approach is bringing people together to talk through difficult issues. We seek to help people find consensus if possible, or at least to better understand areas of disagreement where consensus is not possible.
    c. GPI has worked in a variety of states across the country, with many different entities, and on many different energy and climate topics. Currently we're working with a handful of states on statewide decarbonization plans.
3. Process Objectives:
    a. Ensure the Carolinas Carbon Plan is informed by input from a wide range of stakeholders.
    b. Enable a transparent conversation about how to plan an energy transition that prioritizes affordability and reliability for NC and SC customers.
    c. Build on areas of agreement, clarify areas of disagreement, and seek opportunities for collaboration in advance of filing the Carolinas Carbon Plan.
4. Timeline:
    a. Stakeholder engagement will happen across three meetings from now through late March. The plan must be submitted by May 16th, and then there will be supplemental engagement before the plan has to be finalized before the end of the year.

b. This builds on a lot of work that has already happened on these issues, so while this is a fairly short timeline, it will build on the work that has already occurred. There will also be additional opportunities to engage at the Commission.

c. Scheduled Meeting Dates:

   i. Tuesday, January 25th

   ii. Wednesday, February 23rd

   iii. Tuesday, March 22nd

   iv. NOTE: Future meeting agendas will be based on feedback received today

5. Ground rules:

   a. Respect each other: Help us to collectively uphold respect for each other's experiences and opinions, even in difficult conversations. We need everyone's wisdom to achieve better understanding and develop robust solutions.

   b. Focus on values and outcomes: Today's discussion is about what stakeholders value in the energy future, and how the Carolinas Carbon Plan can align with those values. Pending legal issues are outside the scope of this conversation.

   c. Chatham House Rule: Empower others to voice their perspective by respecting the "Chatham House Rule;" you are welcome to share information discussed, but not a participant's identity or affiliation (including unapproved recording of this session).

   d. Respect the time: Our time together is limited and valuable, and we have a large group, so please be mindful of the time and of others' opportunity to participate.

   e. Use the chat: Please submit your comments and questions in the chat. GPI staff will monitor the chat to pull out questions for Q&A portions. Please be respectful and focus on issues, not people.

   f. Raise your hand: During dedicated Q&A portions of the meeting, use the "Raise Hand" feature to indicate you would like to voice a question or comment.

6. Meeting Materials and Feedback

   a. Meeting recordings (Q&A portions of meetings will be removed to adhere to the non-attribution rule) and meeting summaries will be uploaded to the website for participants to access: www.duke-energy.com/CarolinasCarbonPlan

   b. Information/feedback can be sent to: DukeCarbonPlan@gpisd.net

II. Duke Welcome

Stephen De May, State President, North Carolina and Mike Callahan, State President, South Carolina

1. Welcome from Stephen De May, State President, North Carolina

   a. The purpose of these meetings is to hear from our customers, our communities, and others impacted by a clean energy transition so that the proposed Carbon Plan is informed by stakeholder input.

b. The Carbon Plan proposal will be for both Carolinas. Our utilities span both states, and customers in both states have long benefitted by sharing the costs of an integrated system. Therefore stakeholders from both states will have a voice in this process.

c. Our goal is to develop a proposed Carbon Plan, one that reflects a least cost pathway to decarbonization targets, and does not compromise system reliability.

d. Only our regulatory commissions have the authority to approve a final plan for each state, but as the regulated utility charged with implementing the plan, we have a perspective to share in the plan's development and fully recognize this stakeholder group has perspectives to share as well.

e. To make this experience as productive as possible, it's important to set the stage. Duke will be doing a lot of the talking today, but the process will become more interactive as it progresses.

f. Today is about the technical approach to developing the plan, rather than legal or procedural aspects. But I did want to address the company's proposal for joint proceedings between the North Carolina and South Carolina regulatory commissions. We met some resistance to that proposal, so to prevent procedural concerns from detracting from the important work of developing the Carbon Plan itself, we filed yesterday for withdrawal from those dockets in both states.

g. Our job in these sessions is to develop a Carbon Plan that benefits both states, with input from stakeholders in both states. We are ready to take bold, visionary steps, and to consider new approaches. We are equally committed to providing the reliable service and affordable power that the Carolinas depend on.

2. Welcome from Mike Callahan, State President, South Carolina

a. This process is going to reshape the energy landscape for the Carolinas. Duke Energy operates our utilities across states lines and has done so for generations. This has benefitted customers in both states by providing affordable and reliable electricity, based on a strategy of building power plants where they make sense and having customers in both states share the costs.

b. To illustrate this, the W.S. Lee combined cycle plant in South Carolina is paid for at retail 76 percent by North Carolina customers. The same is true for other assets we operate in South Carolina. On the other side of the state, Robinson Nuclear Plant in Hartsville is paid for 90% by North Carolina customers. The inverse is true in North Carolina, where South Carolina pays about a quarter of the cost for DEC assets and about 10 percent of the costs for DEP assets. This reinforces how intertwined our operations are in both states.

c. We are past the point where clean energy is a choice. The utility sector is moving in this direction, and if we can't move the Carolinas together, we could lose momentum, which would not be good for our economies or our customers, who tell us they want us to reduce carbon emissions.

d. The transition is already underway. Duke has been closing coal plants for a number of years. Electricity doesn't stop at the state line, so there is no easy or cost-effective way to reduce emissions or to plan for generation needs in both states on a standalone basis. We believe this shared system has served both states well through economies of scale.

III. Introduction to Resource Planning and Decarbonization in the Carolinas

Glen Snider, Duke Energy

1. In trying to do this, we're balancing three key perspectives of sustainability, affordability, and reliability
    a. Sustainability: we've been decarbonizing our portfolio (moving away from fossil to renewable resources) for a number of years. In addition to carbon reduction, we're striving to continually improve our footprint across land, air, and water as well.
    b. Affordability: Every resource we add to the system has a different cost profile that goes into the planning process and that we need to consider. These costs can be viewed from different perspectives (e.g., cumulative costs over time represented as present value of costs or annual bill impacts). Plan to look at costs from multiple perspectives.
    c. Reliability: A core asset of power delivery. Need to serve customer demand that varies yearly, monthly, hourly, and by the minute. Also need to have resources to meet demand over extended periods where customer demand is very high. And need to consider backup resources to provide power when other resources are unavailable due to things maintenance, weather, etc. Finally, need to maintain flexibility to meet real-time changes in customer demand.
2. Reliability requires responding to variability
    a. We're looking at every hour of every day between now and 2050, from all three perspectives (sustainability, affordability, reliability).
    b. Gross demand: the total demand for energy throughout the day.
    c. Net demand (load net of renewables): the resulting demand once you account for generation from renewables to reduce the need for non-renewable resources.
    d. The real-time variability of both demand and renewables creates the need to have a flexible system that can respond to that variability, with resources that can follow customer demand during times when wind and solar are not producing at full capacity.
    e. One of the challenges of developing a resource plan or carbon reduction plan is keeping those three perspectives in mind, while also looking across multiple points in time where demand and resources may look different.
3. Elements of decarbonization: how do you look at all of these variables over time?
    a. We start by first looking at the grid edge or customer side of the equation (e.g., efficiency programs, demand side management programs, rate design to encourage usage at times of day when energy is cheaper or renewables are producing). Addressing the customer side first helps to minimize the need for generation resources and other system infrastructure. In other words, reduce the size of the challenge.

  b. Once you've maximized potential on the grid edge, what carbon free resources can be added (e.g., solar, wind, modular nuclear)? Looking to add carbon-free resources as carbon intensive resources are being retired.
  c. Also need to look at dispatchable resources in terms of energy storage technologies to shift loads and ensure reliability.
  d. Displacing coal with very efficient, hydrogen-capable natural gas can also be part of the solution on the trajectory to 70 percent and net zero, since natural gas provides an initial reduction and hydrogen would allow reaching net zero.
  e. There's a wide array of technologies with different physical, financial, and other characteristics. What we're trying to accomplish is the right mix of these resources that can meet our goals.
  f. This is all a simplification, but we need to have a structured way of tackling a complex problem.

4. Executing a plan within a plan: We're going to present a plan for the Commission's consideration that looks all the way to 2050. That creates a good long-term view, but it also develops the need for a plan within a plan:
   a. Roughly three levels of planning needed:
      i. Traditional resource planning: what's going to happen within the next decade, and how to meet the interim 70% goal? This will focus on a mix of technologies that are available today and known and executable, as well as enablers that are needed to support execution.
      ii. Mid-term planning: This will phase from the initial decade into the longer-term plan, which will look at emergent technologies (e.g., advanced nuclear, off-shore wind).
      iii. 2050 planning: Much more uncertainty around what customer load will look like and the resources available to serve that load. Will be working around signposts that signal the pace of advancement, looking at technology pilots, considering policies that will be needed to assist with the transition. There are elements of this timeframe that are unknowable today (e.g., what technologies will be available by this point in time? How much of a role will they play?).
5. Periodic updates will incorporate new information
   a. Past policy and current policy calls for these plans to be updated periodically so that they can be adjusted. Our understanding of uncertainties will improve over time, though at the same time, our ability to pivot and shift will diminish as we get closer to the end goal.
6. Conclusion:
   a. The 3 perspectives of sustainability, affordability, and reliability need to be looked at holistically.
   b. No single resource can solve this – need to look at a mix of resources and how they fit into the broader portfolio.
   c. Clarification – net zero refers to the fact that the last few quantities (e.g., final 5 percent) of carbon may be achieved through an emergent offset market. These

markets could rely on things like forestation and excess reductions from other locations. This ultimately depends on the advancement and availability of zero carbon technologies.

IV. Road to 70 Percent Emissions Reduction and Net-Zero Future

Mark McIntire and Mike Quinto, Duke Energy

1. Background
    a. Unlike the 70 percent greenhouse gas emissions reduction goal that was in the North Carolina Clean Energy Plan, this is focused solely on carbon dioxide emissions.
    b. This is a two-state plan to serve both North and South Carolina, but a lot of the focus in this presentation is on North Carolina given the need for compliance with NC House Bill 951 and the NCUC's requirements for the Carbon Plan.
2. CO_2 Emissions Data Considerations
    a. Want to ensure the data is publicly available, credible, reliable, and repeatable year-over-year.
3. EPA eGrid
    a. One of the preeminent sources for this is the Environmental Protection Agency (EPA) Emissions and Generation Resource Integrated Database (eGRID).
    b. Reliable and trustworthy source with plant-specific data for all U.S. generating plants. Used for regulatory purposes by utilities and government agencies.
    c. Emissions data sources:
        i. Uses EPA's Clean Air Market Division (CAMD) Power Sector Emissions Data – reported to EPA by electric generation units to comply with regulations.
        ii. Emissions data primarily uses actual measurements of CO_2 in stack emissions.
        iii. Where actual measurements are not available, estimated emissions can be used.
    d. CO_2 emissions included in baseline and future actual emissions
        i. Owned: Stack emissions associated with the ownership share of electric generation facilities located in NC and owned by DEC/DEP.
        ii. Operated by: stack emissions associated with electric generating facilities location in North Carolina and operated by DEC/DEP
        iii. Operated on behalf of: Located in NC, but not owned or operated by DEC/DEP, but contracted to sell electrical output to DEC/DEP (wholesale power producers, small producers, and cogeneration systems).
            1. When looking at cogeneration, only the emissions associated with electricity generation are counted.

iv. NOTE: Emissions from the use of fuels like biomass, which are not producing net emissions (as the fuels are part of the natural carbon cycle) are not counted.

e. Carolinas Combined Fleet Transition Progress

   i. Coming from a 2005 fleet that was primarily coal and nuclear.

   ii. Progress to date, represented by the 2021 projections from the 2020 IRO, shows reduced coal usage, added lower carbon fossil resources (e.g., natural gas), and increased carbon-free generation.

   iii. The 2020 IRPs projection for 2035 (from the Base Case with Carbon Policy, so the Carbon Plan will be more aggressive) foresees coal nearly phasing out and carbon-free generation increasing.

f. Baseline, progress, and 70 percent reduction target

   i. 2005: 76 Million tons CO2 emissions

   ii. 2019: 47 Million

   iii. 70 percent reduction target: would need to reach less than 23 Million tons emitted.

g. Decarbonization replacement resources (what's needed to achieve the 70 percent reduction):

   i. Demand-side resources will be important (e.g., energy efficiency, demand response, rooftop solar). These will help to reduce the need for new generation.

   ii. Solar will be a key tool and is already being deployed today at scale. We expect this to continue and to be a large part of the decarbonization pathway,

   iii. Emerging technologies (or technologies not yet widely deployed in our region) – onshore and offshore wind. See a gap in deployment around 2040's where new wind resource areas would not be accessible.

      1. Explanation of offshore wind gap: To do offshore wind, need access to lease areas where the turbines can be built, and these areas are limited. In the early to mid-30's we would use up the lease areas available today. After that, new lease areas will to be opened up, and we expect that process will take some time, so that's the gap.

   iv. Advanced nuclear: can be used for system flexibility and responding to intermittencies and variable energy resources. Potential for bulk energy and can be integrated with storage and used to make hydrogen.

   v. Hydrogen-capable combined cycle turbines – an important option for the future.

   vi. Energy storage: Multiple forms. Need to remember that these are load on the system. The goal is to use these to charge when demand is lower and discharge when demand is higher and generation is more expensive and potentially more carbon-intense.

1. Pumped hydro: Available and used currently. Have over 2,000 MW of this on the system today, but potential with the geography in the Carolinas for additional resource capacity.
2. Batteries: Continuing to decrease in price and looking at how the market is evolving.
3. Hydrogen storage: Deployment starting to increase and there's excitement about the capabilities for it to support variable energy resources. Will continue to look at how it can be produced and used at large scales. It will need to be produced from carbon-free resources to be considered green and further reduce carbon emissions.

h. The NC/SC system must be built preserving reliability

   i. Graphs on this slide are intended to help stakeholders understand how the system might operate in extreme winter conditions. These graphs are generated from the Companies' Portfolio Screening Tool on its website. In specifying different energy mixes within the tool the user can show how generation can be used to meet load in high load winter and summer periods and low load shoulder periods
   ii. Top left graph is a reflection of how the system has been operated in the past, with baseline nuclear and coal and gas providing dispatchability to support the system, with very little energy from variabile energy resources such as solar.
   iii. Acknowledge that going forward, the system will need to operate differently while maintaining reliability. Bottom left graph shows that we'll eventually need to move away from coal and will rely more on variable energy resources and storage to reduce carbon. Red portion is unserved load, so need to avoid that happening.
   iv. On the right, this shows load net of solar production from DEP a couple days ago. As we look at load net of renewables, the rest of the system needs to be able to meet this load and respond to the variability of the system.
   v. On a cold winter morning, see a peak around 7am in the morning, around 11,50 MW of load. As the sun comes out, load goes down towards a low point of about 6,500 MW around 2pm. Then, as the sun goes down and folks come home from work, load goes back up to about 11,000 MW around 8pm. Need to provide reliability for all times of the day, on an hour-by-hour, minute-by-minute basis.

V. Clarifying Questions

Glen Snider, Mark McIntire, and Mike Quinto, Duke Energy. Facilitated by Doug Scott, Great Plains Institute.

1. Are emissions associated with electricity exported from Duke's system also included? What about electricity imports where there is no long-term contract established?

a. The baseline emissions are embedded in HB 951 – goal and baseline are associated with in-state emissions of CO_2. That doesn't mean Duke isn't concerned with other greenhouse gases, it's just the requirement for compliance with the NCUC's order on the Carbon Plan. Exports will be included, but imports will not (because they're not in-state).

2. Storage: what kind of storage factors are you considering in the forecast of what would be available?
   a. Looking at both chemical storage (e.g., lithium ion batteries) and non-chemical storage (e.g., pumped storage, compressed air). Acknowledge that what's available today will be different from what's available 20 years from now. Interim goal will look at what's available today, long term goal will look to emerging technologies.
3. How can Duke use customer-sited resources like rooftop solar in its planning?
   a. Customer-sited resources are the first thing we think of to pursue aggressively to shape load and reduce the size of the total problem we're trying to solve for. We'll be looking more at this later today.
4. Could you give examples of generating facilities that are not owned, but operated by Duke?
   a. Generating facilities that would be partially owned units with some wholesale customers (operate but don't own 100 percent of resource), but operated by DEC/DEP.
5. What percentage of Duke's generation is supplied by imports?
   a. Varies year to year. Sometimes have been a net exporter depending on the needs of surrounding regions, but by and large we have very small net imports and exports compared to our total load obligation (greater than 90 percent of needs met through Duke-owned resources).
6. Electrification beyond vehicles, such as buildings?
   a. It's built into the load forecast. There are different views about the pace of adoption, so we build a view into the load forecast and can dig deeper into it later this afternoon. That, plus customer growth, will put upward pressure on electricity demand. Folks are migrating into our region, on a net basis. Need to achieve our goals despite customer growth and electrification.
7. Can you speak to how you're considering demand flexibility and demand side management?
   a. We use energy efficiency to refer to programs that help customers to use less electricity. Use demand response programs to help change when electricity is used (e.g., shift to a more affordable and/or less carbon intensive time period). Those, plus programs like rooftop solar and rate design help us to meet the load shape
8. How about voltage optimization?
   a. Integrated volt/var looks at the voltage at which customers are being served. Possible to lower voltage within a range that maintains quality of service, but allows saving energy during peak times.

9. What are you doing in terms of methane leakage reduction?
    a. At the holding company level, we are trying to reduce methane leakage upstream by working with pipeline distribution companies. All resources have upstream impacts that we have to qualitatively consider. There is no perfect resource without these issues, but we certainly are trying to drive down emissions beyond our borders. This plan will specifically address carbon, but that doesn't mean we're ignoring other GHG emissions.
    b. We have a net zero methane emissions goal from our natural gas business by 2030. We've been making investments in technologies to detect, address, and fix leaks for some time.

VI. Discussion: Criteria for a Successful Carbon Plan

The following are notes taken on-screen (to ensure accuracy) during the meeting to capture stakeholder responses to the question, "What are your criteria for a successful Carbon Plan?"

This discussion was facilitated by Doug Scott of the Great Plains Institute, with on-screen notetaking by Trevor Drake of the Great Plains Institute. Additional comments that were submitted in the meeting chat will be incorporated into a summary of criteria for a successful Carbon Plan that will be sent back out to stakeholders for review and refinement.

The suggestions are numbered for reference purposes only; the numbers do not indicate a ranking or priority.

1. Where does the carbon reduction goal fit among the 3 perspectives? Interested in the speed of achieving reductions and use of renewables. Would like the crisis nature reflected.
2. How might Duke be looking at incorporating the recommendations from related processes into the Carbon Plan? Should include how to offset cost impacts through programs that focus on low income programs, weatherization, etc. Would specifically like to see the recommendations from the Low Income Affordability Collaborative incorporated.
3. What consideration is Duke giving to combining the balancing areas of the two utilities (and if not considering, why not)?
    a. If not to be combined, is there a plan for allowing facilities located in DEP to serve DEC load? Not possible to achieve this if facilities have to be sited proportionate to load in service territories.
    b. Would like to see consideration of combining IRP's for DEC and DEP (since they currently file separately, but need to meet the same carbon reduction standard)?
4. Reflect the critical role that the electric system has in solving the economy-wide emissions problem – key issue is how effective you are at electrification of other sectors.
5. Per NC law, would be possible to site new facilities in SC. Wondering how Duke is thinking about this. Open and available to Duke to state it will not site facilities in SC – helpful to clarify the approach on this.
6. Last IRP efficiency savings were limited to two levels. Would like to see the Carbon Plan center efficiency and DSM as first choice resources.

7. Would like to see plan accomplish methane reduction goals before selecting new gas as a resource.
8. Would like to see an aggressive storage scenario – projecting storage will be low cost and high duration (because it could send a signal to the market for R&D).
9. See value in open and transparent modeling tools, which will result in better buy-in among stakeholders.
10. Transparency around metrics/assumptions:
    a. Perceived regulatory risk (resources require approval from multiple regulators), such as for advanced nuclear.
    b. R&D investments and emerging technologies
11. Transparency and involving stakeholder input – sharing not just modeling tools, but data inputs to the modeling tools
12. Avoiding lock-in: Begin everything with the end in mind. Don't preclude resource decisions down the road that might have a better cost outlook.
13. Consider regional coordination, including with respect to transmission.
14. Emphasize the hard work done as part of the Clean Energy Plan stakeholder process and ensure this builds on that work. Would like this group to look at the policies that were studied, specifically in the A1 process.
15. Would like to see on-bill financing as an enabler for energy efficiency/DSM
16. Want to make sure we're supporting communities near coal facilities, in terms of the economic and community impacts of plant retirements.
17. When discussing renewables, make sure we distinguish between reliability and variability. These resources are variable, but in a predictable way, which makes them reliable.
18. Be intentional about the siting of new facilities, avoiding areas already disproportionately impacted by energy generation or other industrial facilities (take a holistic approach).
19. Make sure to maintain fair and affordable rates for at-risk households and communities.
20. Risk and resiliency process – want to make sure the findings are incorporated with respect to future siting, future transmission needs, and distributed versus centralized resources (and include the cost perspective with these in mind).
21. This is a climate emergency. Would like to see at least 70 percent by as soon as possible, and 100 percent by 2050 or sooner.
22. Want to ensure we're measuring real reductions (e.g., swine biogas gets too much credit compared to its contribution to reductions)
23. Suggest a carbon equivalency plan, rather than just a Carbon Plan.
24. Would like transparency on pricing – what is this going to cost us? Especially important to industrial customers.
25. Importance of trying to achieve consensus on as many issues as possible prior to filing. Litigation is not the best way to get the best outcomes.
26. Increase in natural gas generation in base case:

a. Climate crisis is one of cumulative emissions, not specific points in time (if we emit a lot of carbon towards 2050, but still hit the target, we'll make the problem worse)

b. Want to avoid building gas plants that will not survive their useful life, and could cause rate impacts

27. Value early action to maximize distributed resources and acknowledge the unique benefits of different scales of generation resources.
28. We can't ignore the 2050 goal – keep it in mind as we seek to meet the interim goal.
29. Having some metrics or ways to identify or ensure we're implementing HB 951 mandates in each of the 3 perspectives is key.
30. Would like to see an option included with a very high level of distributed resources, and all currently available mechanisms for those resources to shift load out of peak periods.

VII. Introduction to Modeling

Robert (Bobby) McMurry, Duke Energy

1. Models, inputs, and assumptions
    a. Goal is to ensure the expansion plan meets the three objectives described above.
    b. Capacity expansion planning models the "what:" what is needed to meet our needs over time, in terms of existing and new generation.
    c. Production cost modeling is the "how:" how the system will operate on an hourly, seasonal, and annual basis.
    d. Storage is not shown on the slide, but it's very important to the system and will be considered (as described earlier)
2. Models
    a. Duke recently switched to a new capacity expansion and production cost modeling software called "EnCompass." It's relatively new and offers more features than previous tool, including…
        i. Modeling multiple constraints at once
        ii. Ancillary services (e.g., regulation and balancing reserves)
        iii. Emission caps
        iv. Renewables requirements
        v. Monthly reserve margins
        vi. Advanced storage logic
        vii. Dual fuel optimization (e.g., some plants can run coal or gas)
        viii. Economic retirement of power plants
    b. Reliability tools

        i. Regulation and Balancing Reserves (ancillaries) – provides reserves needed to account for day ahead changes and inter-hour volatility.
        ii. Strategic Energy and Risk Valuation Model (SERVM) -- reliability check to assure portfolios will not exceed 1 loss of load event per 10-year period

3. Inputs
    a. Load forecast (includes efficiency, electric vehicles, behind-the-meter generation etc.)
    b. New generation (capital cost, lifetime, operations and maintenance, efficiency, and constraints for specific types of generation)
    c. Existing generation (operations and maintenance, efficiency, and constraints)
    d. Fuel cost (costs of coal, goas, oil)
    e. Constraints (emissions, reserve margin, ancillaries, transmission)
4. High-level planning process:
    a. Start with a scenario, with all of the inputs listed above.
    b. Capacity expansion looks at what resources are needed to meet the constraints.
        i. It’s a screening tool – it accounts for a typical day load shape and for the peak load.
        ii. Important to get the ancillary requirements right given the specific mix of resources
    c. Production cost model looks at operations and impacts from an hourly basis – what is our fuel cost through time, what are our emissions projections through time, and how will the system operate under this scenario?
    d. Conduct a check to ensure that the scenario is reliable for both long and short term events, and also consider the transmission and distribution constraints of new generation (e.g., can it be interconnected?).
    e. Overall, each scenario is designed to consider a range of sensitivities that can help with selection of an optimized plan.
5. Q&A
    a. Could you clarify, which processes are done by encompass versus other methods?
        i. Retirement analysis, capacity expansion and production cost modeling is done by EnCompass. Ancillaries and reserves are developed in-house.
    b. Is there somewhere where the inputs and assumptions are available to stakeholders, to help folks understand the modeling better?
        i. Many of our inputs relating to operating units are proprietary due to the competitive nature of the information.
        ii. There are hundreds of inputs and assumptions that go into the modeling. To the extent we can, we’re trying to use transparent and publicly available data sources, though in some cases that information is internal.

We'll be making efforts before and after filing to be transparent with that information.

iii. If stakeholders have suggested sources to inform the assumptions and inputs, we want to see that.

c. Does Duke set a CO2 limit, and then let the model select?

    i. We do it based on a mass cap and/or an allowance price that will make the model take action in the same way as though there's a mass cap (the allowance would just be used as a modeling constraint, it wouldn't be an actual carbon tax policy)

d. What is mass cap?

    i. It's the specific quantity of emissions that the portfolio can emit. The model must solve for a mix of resources that stays within the cap and meets all the other constraints.

e. What are ancillaries?

    i. We have additional reserves to account for day-ahead schedule variance (e.g., load is different than day-ahead planning) and inter-hour volatility.

f. Will the modeling show the rate increase to customers?

    i. In addition to looking at the cumulative cost of the plan, we will be looking at the annual impact on an average bill across time.

VIII. Coal Retirements Modeling Methodology

Mike Quinto, Duke Energy

1. Coal in the Carolinas (as of 2020 IRP)

    a. It's important to recognize the role that coal had in our portfolio and how that will change going forward. It's provided reliable energy for decades, with the ability to be available when called upon. Now, need to be thinking about when to replace coal resources with those that are more economic and carry less risk for customers. This is one of the big questions we need to address.

2. Coal retirement analysis background

    a. Previous IRP's used the retirement dates from DEC/DEP's most recently approved depreciation study. However, as of 2020 IRP process, the Companies conducted an economic coal retirement analysis – a comparison between your existing capacity costs versus the costs of replacement capacity.

    b. When a unit is retired and what it is replaced with can change the analysis.

3. DEC/DEP Coal Fleet Statistics

    a. 15 units that are fueled with coal, but some of them can be fueled with either coal or natural gas, which can impact the analysis.

    b. In the 2020 IRP, we conducted an economic retirement analysis – those results are listed on slide 44. Many of them are within the IRP planning horizon.

c. Important to use this as one tool to find the least cost pathway toward the carbon reduction goals.

4. Stakeholder feedback received (previous to this process) for coal retirement analysis:

   a. General feedback:

      i. The magnitude and complexity of this problem is very large – takes a lot of computing and lots of options for how to do it.

      ii. Modeling limitations – would like to capture every bit of uncertainty, but some aren't practical to capture through modeling (even if they're acknowledged)

      iii. Transparency in understanding why a unit was selected for retirement and what it would be replaced with

      iv. Desire and need for straightforward process with standard methodology

      v. Removing objectivity from the analysis

   b. Key considerations

      i. Retirements should be considered simultaneously

      ii. Replacement resources should include the option of multiple resources to the fill the gap of a single plant retirement

      iii. Retirements should be co-optimized with replacement resource development

      iv. Retirements should be determined by the net exchanges in investment, maintenance, and operations cost of the system as a whole

      v. Impacts to the transmission system – acknowledge it's difficult to identify and capture in the IRP modeling.

      vi. Recognizing the investment in these resources changes over time as they approach retirement, and costs for replacement resources change too.

      vii. Need for retirement dependency and capturing shifting ccosts

      viii. Sunk costs should be excluded, such that only avoidable costs should be considered.

   c. Summary of approach in Carbon Plan

      i. Will use endogenous economic selection of coal retirement in Encompass's capacity expansion model.

         1. Will model the determination of order and timing of retirements

         2. Will consider co-optimization of retirements and replacement resources.

         3. Will capture net cost differences in investment, maintenance, and operations cost of the system.

      ii. Still evaluating capabilities of model to handle the analysis

      iii. Option to evaluate coal retirements in sequential process in production cost model.

iv. Retirements are dependent on replacement resources, and may be adjusted slightly to support orderly transition or maintain reliability.

5. Q&A

a. Are you planning on changing the 1-in-10 year loss of load standard?

   i. No, this is not changing.

b. Does the continuing cost of managing coal ash and other environmental costs fit into the analysis?

   i. We are considering incremental coal ash, but not coal ash that is currently a byproduct of the system (because this is a sunk cost).

c. Are there additional upstream costs such as pipeline investment that are factored in?

   i. Yes, fuel supply costs are considered.

d. Is the ability to do storage at coal plant retirement sites factored in?

   i. Any replacement resource can leverage the existing transmission infrastructure. Storage is unique because it has to be able to charge and discharge (whereas a coal plant may have been set up only to discharge energy).

e. How is EE and DSM modeled as a replacement resource?

   i. The EE cost effectiveness framework looks at energy efficiency relative to other options – is it lower cost than the alternatives you'd have without efficiency?

f. How many sensitivities do you plan on running? How about gas prices?

   i. Exact number has not yet been determined. There is a finite limit to the number that can be considered before the process becomes too unwieldy. Have seen in past resource planning processes that gas pricing is an important variable, so likely will be included.

   ii. If there are scenarios or sensitivities that stakeholders feel strongly about, Duke would like to hear those.

g. Are you using the economic retirement analysis from the 2020 IRP?

   i. We'll be using the knowledge we've gained through that analysis as a foundation, but updating it with new tools, approaches, and inputs.

h. Looking forward, do you envision storage scenarios longer than 4 hours in duration?

   i. There's a host of storage on the horizon with longer durations, such as flow batteries. Intend to look at a reasonable fleet of storage options with credible cost and performance assumptions for the model to choose among. Will also consider how much value they have on the system from a capacity basis.

IX. Load Forecast Drivers

Brian Bak, Tim Duff, and Matt Kalemba, Duke Energy

1. Energy Efficiency
    a. Energy efficiency forecasting
        i. Market potential study – provides a comprehensive assessment of EE/DSM potential using the best data available at the time, with results specific to service territory and customer base. Most recent study was completed in June 2020, but working to provide an update in support of both integrated resource plans and the Carbon Plan, though it likely won't be completed in time to be fully integrated into the Carbon Plan. Includes all currently known technologies, estimated costs, and energy and demand reduction impacts.
    b. Forecast – base case
        i. Traditionally, take internal projections of what can be achieved to develop the first 5 years, then transition to using the market potential study (25-30 year horizon).
        ii. Cumulative energy savings grow rapidly in the initial years, plateaus, and then starts to decline.
            1. The base case continues to add energy savings throughout the entire planning period, but the new savings don't keep pace with the legacy savings from previous measures that are reaching the end of their lifetime deemed savings (savings are still there, but they become incorporated into the overall load forecast), which is why it declines in later years.
            2. Incremental additions also don't keep up because the market potential study is based on currently available technologies, so you reach saturation of those in later years. Hoping the updated to the market potential study might address this by looking at new technologies and end uses.
    c. Forecast – 1% of available retail load
        i. Every MWh that we don't have to serve is carbon avoided, so assuming we can save 1 percent in each year of the planning horizon. This assumes we'll come up with new measures and concepts in later years to maintain this, above and beyond what the current potential study has forecasted.
    d. Moving beyond the Carolinas' base EE/DSM forecast
        i. Recognizing the important that energy efficiency can play, want to look at how to get beyond the base forecast and even beyond the aggressive forecast.
        ii. Consider this across four key avenues:
            1. Technical potential – expand the number of potential measures that can be deployed.

2. Economic potential – help measures to meet cost effectiveness tests.
3. Achievable potential – remove barriers that customers have to participating in EE/DSM programs.
4. Program potential – budgeting constraints and enhancements to the existing programs and measures (e.g., bundling) to make as much use as possible of approved programs.

iii. Structural modifications and mechanisms to remove market barriers to program participation (achievable potential):

1. On-tariff -- financing program with necessary regulatory recovery mechanism that helps remove upfront cost barriers or credit barriers to undertake efficiency programs.
2. Marketing enhancements – better using advanced metering data to target programs to customers who will best benefit from them

iv. Modification to cost effectiveness (economic potential):

1. Value of carbon – can factor into the evaluation of cost effectiveness and make new programs cost effective or allow the expansion of existing programs.
2. As found energy savings recognition – look at savings generated compared to what is actually being replaced, rather than based on the efficiency of the new device alone.
3. Recognition of localized customer program values – identify overloaded circuits and target customers on those circuits to reduce spending on transmission and distribution, and make measures in those locations more cost effective.

v. Modifications to expand potential measures and offers (technical potential):

1. Utility codes and standards program – today we look at efficiency versus the current building codes and standards. If utilities can get credit for helping to meet standards, it can create additional opportunities,
2. Customer owned assets that reduce grid consumption – how can we make the energy being consumed from the grid as efficient as possible (e.g., rooftop solar can reduce utility grid usage).
3. Efficiency for electrification loads – opportunity for things like electric vehicles.
4. Modifications to non-residential opt-out – provision where non-residential customers can opt out of efficiency programs. Modification to gain more participants would improve efficiency offerings.
5. Expand EE programs to wholesale customers (i.e., those who take generation service from the Duke system, as opposed to retail service).

e. Q&A

i. Were the slides showing kWh or dollars?

1. kWh

ii. Is there any factoring in of the quantity of carbon that would be saved through efficiency measures?

1. Yes, still working on that for the Carbon Plan

iii. Are there sensitivities for federal or state carbon regulations?

1. Not aware of any specific requirement regarding the level of efficiency. To the extent it would create transparent value around how carbon would be factored in, it could expand the potential for efficiency.

iv. Is there a value yet for the cost of carbon?

1. Not to our knowledge yet – it's a question that applies to more than just EE.

v. Is the 1 percent shown of retail load, or does it take into account the industrial opt-out?

1. It's of available load, so does not include the opt-out.

2. So does it equate to .65 or .7 percent?

a. We'd have to look at the exact number, but the concept is right and that's probably in the ballpark.

vi. Will you incorporate these winter morning DSM/EE scenarios into your underlying LOLE analysis?

1. Yes, they will be incorporated in those studies

vii. Is the 1 percent modeling lower than Duke's achieved EE savings performance in recent years?

1. No, not in recent years. There was a period where we were seeing close to 1 percent, but that was prior to COVID and changes in lighting standards that increased the baseline (making measures less cost effective).

2. Net Metering and Solar Forecast

a. Current Modeling Approach

i. Rooftop solar adoptions across the Carolinas in DEC and DEP – roughly 50,000 adoptions by the end of 2022. Average annual growth of 9% in DEP and 11% in DEC.

ii. Forecast based on a payback model – what's the customer's benefit of installing solar, as opposed to the cost. Use that to determine a payback period and compare that to past adoption behavior to make a forecast.

iii. Solar costs – using today's costs with a price decline of 15-20 percent through the end of this decade. Do include the ITC until its scheduled roll-off in 2024.

iv. Two ways to adjust the modeling – interested in feedback from stakeholders on what they'd like to see:
    1. Adjust the inputs -- more aggressive price declines, reinstatement of the ITC, or more aggressive adoption rates
    2. Set a target for solar adoption that the model strives to hit.

b. Q&A
   i. Existing or new net metering?
      1. New
   ii. Commercial rooftop solar included?
      1. Yes
   iii. Why is there such a difference in rooftop solar between DEC and DEP?
      1. Some of it had to do with modeling customers who have all electric service versus dual fuel.
   iv. You said you're modeling current tariffs with respect to customer owned solar adoption.
      1. The current tariffs provide the base case of what we know have been approved. Increased adoption can be a reflection of different tariff structures.
      2. There's a proposed update to NEM that is still pending.
      3. As noted above, also looking at providing an energy efficiency incentive for solar adoption that reduces power from the grid.

c. Electric Vehicle Adoption
   i. Current Modeling Approach
      1. Base cases for DEC and DEP – plug-in electric vehicles (including hybrids) are 11-12% of new vehicle sales by 2030.
      2. High cases are 44-46 percent by 2030, 100 percent of new vehicle sales by 2040.
      3. Includes light, medium, and heavy-duty vehicles
      4. EV's represent about 1.5% of total energy by 2030 in the base case and 3-4% in the high case.
      5. Other options:
         a. Update base scenario accounting for increased commitments from EV manufacturers and accelerated EV adoption
         b. High case that achieves President Biden's goal of PEVs making up 40-50 percent of new vehicle sales by 2030.
   ii. Q&A
      1. How about V2G?

a. Something we're trying to figure out how to incorporate, and likely will look closer at it down the road.

X. Key Modeling Cost and Forecast Assumptions

Matt Kalemba, Adam Reichenbach, Robert (Bobby) McMurry, Duke Energy

1. Solar Interconnection Forecast
   a. Background
      i. Solar is a least cost resource for carbon free generation, so need to make sure we can get solar onto our system through interconnection. It's unique because it requires more land per MW than almost any other resource. Have already connected 4,000 MW of solar in areas that were once unconstrained, but with the influx of solar, those areas are now transmission constrained. There are less unconstrained areas remaining that are suitable for solar, as a result, interconnecting solar becomes more expensive and takes longer to get on line if it requires transmission system upgrades to interconnect."
      ii. Historically, solar interconnections have been variable and most recently affected by COVID. Have averaged 510 MW/year of solar interconnections since 2015; approximately 9 transmission level interconnections annually.
      iii. Time from signing interconnection agreement to in service date, in months – lots of variability in the time to interconnect, but also the average time to interconnect is increasing from 15-30 months to 30-50 months.
   b. Sensitivities
      i. Under current trends, we won't see new projects come online until 2026-2030.
      ii. Three scenarios being looked at for interconnection from 2026-2030 that allow the model to select up to a certain amount (cumulative numbers include 4,000 MW already connected):
         1. Transmission constrained – up to 400/500 MW per year, adding up to 9,400 MW solar connected by 2030. Takes into account things like transmission constraints or limited land availability.
         2. Progressive – up to 750MW/year, adding up to 11,000 MW solar connected by 2030.
         3. Enhanced Transmission Policy (that would enable strategic transmission investments and alleviate constrained areas) – still determining what this would look like in terms of MW of solar that could be selected per year
   c. Q&A
      i. If you look at Duke's 2020 IRP and the 70 percent decarbonization scenarios, they call for a total of over 16 GW of solar, and that's in conjunction with some very ambitious wind energy numbers. We're

talking about needing a lot more solar than 9-11 GW, so how do you envision being able to accomplish that given the annual additions that appeared in the slides?

1. The 16 GW of solar was through 2035; we are focusing on solar by 2030 in the table. However, the reason we're discussing this as a constraint is to highlight the fact that we need to develop plans to be able to interconnect more solar, so agree with you that interconnecting more solar will be important to meeting the carbon goals, and want to acknowledge the transmission constraints.

ii. Do you all have a plan or concept for what the enhanced transmission policy might look like?

1. Can't speak to the details, but know there is an internal team looking at this.

iii. Want to reiterate that transmission improvements are mission critical and will have significant impacts on costs. Would request that the company set up a working group to accomplish this.

2. Technology Forecast

a. Existing technologies or near-term emerging technologies that Duke believes will be available within the planning horizon (see table with full details in slide deck):

i. Solar PV with tracking

ii. Offshore wind (note the 10-year moratorium coming up)

iii. Onshore wind

iv. Battery storage

v. Pumped hydro (has both pumping and generating capabilities)

vi. Advanced nuclear

vii. Combined cycle (with option to switch to hydrogen for fuel)

viii. Combustion turbine (with option to switch to hydrogen for fuel)

b. Technology learning curves towards 2030

i. Cost declines of 5-12 percent: Established technologies and very emergent technologies, including onshore wind, small modular nuclear, combined cycle, and combustion turbine.

ii. Cost declines of 34-57 percent: Technologies being deployed and seeing significant cost reductions, including solar PV with tracking, battery storage, offshore wind.

c. Q&A:

i. Source of capacity factor estimates?

1. A couple different sources, both external (Burns & McDonnell, Guidehouse, and EPRI) and internal data from existing plants.

ii. How many advanced nuclear facilities exist?

        1. Two designs being deployed in the U.S., but nothing built currently. A small modular reactor is being built in Utah. There are some projects globally.

iii. Why is pumped hydro not considered as peaking as well as intermediate? Is that because of limited generation capacity at the facility?

    1. It is a peaking resource as well.

iv. For hydrogen to replace natural gas, where would the hydrogen come from, and how are you thinking about that?

    1. This is emergent, so we're still looking into it. Hoping green hydrogen from electrolysis will be a possibility, but the question is how much will be available. For reference, green hydrogen is hydrogen created via electrolysis from carbon-free energy sources such as solar, wind, and nuclear. Would need large quantities of hydrogen to fuel a combined cycle plant. Actively studying this, but hard to say definitively for the 2030 timeframe.

v. Any geothermal development?

    1. Watching it and have heard from some companies doing it, but currently seeing that geology in Carolinas does not make it economical, though open to changing assumptions in response to new information.

vi. Learning curves and cost declines – where is that information coming from? What are the SMR costs based on (given some projects have had delayed and overruns)

    1. Dark blue in slide 65 is the EIA number. Light blue is engineering that Duke does where they don't think EIA was aggressive enough. These are all about capital cost declines.
    2. On SMR's – believe the question is in response to a project in Utah where there was confusion about two different cost estimates – one was the cost as if the project was built overnight, the other was the actual cost to build.

vii. Are heat pumps considered?

    1. Yes, but not in this area – these are generation technologies.

viii. Heard an argument that cost declines would support a later deployment of technologies – believe this should be reframed as to whether technologies are economic and least-cost now.

    1. Probably misconstrued what I meant there. For deployments that will be much cheaper within a few years, later deployment could save customers costs, but acknowledge that we should not delay technologies that we need to meet the goals and that are economical now.

3. Natural Gas Price Forecasting

    a. Historically in the IRP, have used projected market gas prices for the first 10 years, followed by 5 years of blending market gas data with fundamental fuel prices (using biannual data from IHS CERA), followed by a forecast that is based 100% on fundamentals. Fundamental prices have tended to be much higher than market prices, though this hasn't always been the case, it's been variable.

b. For North Carolina IRP, ordered to use no more than 8 years of market prices.

c. Proposed change for Carbon Plan and future IRP's – Use market gas data for only the first 5 years, followed by a 3-year period of blending market gas with fundamentals (using an average of EIA, EVA, IHS and Wood Mackenzie), followed by 100% fundamentals; coal and gas would be on the same blending basis.

    i. Goal of doing this is to work in a blended time period within the 8 year limit, otherwise a sudden shift from market prices to fundamentals can create odd modeling results that jump from one year to the next.

    ii. Proposing to use an average of four different fundamental pricing sources to decrease volatility from one year to another that can result from using a single source.

d. Q&A

    i. How are you considering cost uncertainty or sensitivity analysis in its considerations of natural gas? Uncovered gas volumes are a risk to ratepayers.

        1. We recognize commodity price volatility has an impact on the plan. Looking at multiple reputable sources on what the long run cost will be – those long run fundamentals are what drive the model selection choices. Will also look at how sensitive the choices are to the fuel price assumptions.

    ii. In the forecasting community, the way people deal with uncertainty, they look at a distribution of gas prices in the future, and then one comes up with a composite cost across that distribution. But the way it's being done here doesn't reflect the economic risk of the high end. Less of an issue with renewables, but it is an issue with fossil fuels.

        1. Good question. There are dozens if not hundreds of inputs that go into the model, of which commodity prices are one. To do this out towards 2050 with so many variables, there isn't a good model yet that can do that probabilistically. So, appreciate the comment and understand the point. We do try to look at high and low sensitivities.

    iii. What's the Y axis on slide 67?

        1. This is just illustrative of the commodity price.

XI. Next Steps

1. Slides, the anonymized chat, and recordings of the presentations will be posted on the Carbon Plan webpage at www.duke-energy.com/CarolinasCarbonPlan.
2. Any additional thoughts and suggestions can be sent by email to DukeCarbonPlan@gpisd.net

3. The next meeting will take place on Wednesday, February 23rd. GPI will be sending out an email soon with the link to register.
4. There were several chat comments suggesting a stakeholder workgroup on transmission buildout and interconnection, so stay tuned for more information on that opportunity.
5. Please be in touch with any thoughts or suggestions on anything related to the Carbon Plan, including on the stakeholder process.

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List of Attendees by Organization

Joe Bearden	350 Triangle
Karen Bearden	350 Triangle
La'Meshia Whittington	Advance Carolina
Donald Zimmerman	Alder Energy Systems
Cathy Buckley	Alliance to Protect Our People and the Places We Live
Kathryn Chelminski	Ameresco
Scott Conklin	APCO Worldwide
Rachael Estes	Apex Clean Energy
David McGowan	Api
Rob Jennings	Api
Justin Sykes	API SE Region
Rob Howard	Appalachian State University
Sohad Abu-elzait	Appalachian State University
Josh McClenney	Appalachian Voices
Rory McIlmoil	Appalachian Voices
Elizabeth Ratner	Atrium Health
Michael Roberts	Atrium Health
Greg Andeck	Audubon North Carolina
Christina Cress	Bailey & Dixon, LLP
Kim Campbell	Bailey & Dixon, LLP
George Baldwin	Baldwin Consulting Group, LLC
Brad Visokey	Bank of America
Lisa Shpritz	Bank of America
Oliver Twitchell	BP
Michael Wallace	BrightNight Power

Craig Schauer	Brooks, Pierce, McLendon, Humphrey & Leonard, LLP
Marcus Trathen	Brooks, Pierce, McLendon, Humphrey & Leonard, LLP
Nick Phillips	Brubaker & Associates, Inc./Carolina Industrial Group for Fair Utility Rates
Jeremiah LeRoy	Buncombe County
Preston Howard	Carolina Industrial Group for Fair Utility Rates
Kevin Martin	Carolina Utility Customers Association, Inc
Chris Carmody	Carolinas Clean Energy Business Association
John Burns	Carolinas Clean Energy Business Association
Kathy Kaufman	Carrboro Climate Action Team
Mark Svrcek	Central Electric Power Cooperative, Inc.
Mason Milligan	Central Electric Power Cooperative, Inc.
Ellen Zuckerman	Ceres
Robert Kaineg	Charles River Associates
John Downey	Charlotte Business Journal
Bradford Muller	Charlotte Pipe and Foundry
Steve Rundle	Charlotte-Mecklenburg NAACP
Kevin Lindley	Chatham County
Bridget Herring	City of Asheville
Heather Bolick	City of Charlotte

Jeff Sovich	City of Greensboro
Michael Frixen	City of Greenville
Madison Kluge	City of Salisbury
Brian Morgan	Clean Energy Buyers Association
Joel Porter	CleanAIRE NC
Snowil Lopes	Clemson University
Thomas Suttles	Clemson University
Anthony Putnam	Clemson University Facilities
Amelia Covington	Climate Action North Carolina
Eddy Moore	Coastal Conservation League
Jalen Brooks-Knepfle	Conservation Voters of South Carolina
John Brooker	Conservation Voters of South Carolina
John Tynan	Conservation Voters of South Carolina
John Gaertner	Consultant
Stavros Polyzoidis	Continental Tires the Americas, LLC
Julius Horvath	Core Solar, LLC
Randall Jenks	Core Solar, LLC
PJ Klein	Corning Incorporated
Steve Frank	Corning Incorporated
Nicole Miller	Cypress Creek Renewables
Peter Stein	Cypress Creek Renewables
Tyler Norris	Cypress Creek Renewables
Zander Bischof	Cypress Creek Renewables
Scott Stanco	Department of the Navy
Bernard Givan	Department of the Navy - NAVFAC
Sarah Cosby	Dominion Energy, Inc.
Warren ReBarker	Draughon Farms, LLC
Adam Reichenbach	Duke Energy

Ameya Deoras	Duke energy
Andrew Clarke	Duke Energy
Angela Tabor	Duke Energy
Arnie Richardson	Duke Energy
Benjamin Passty	Duke Energy
Bill Currens	Duke Energy
Bill Norton	Duke Energy
Blain Atkins	Duke Energy
Bo Somers	Duke Energy
Bob Donaldson	Duke Energy
Bobby Mc Murry	Duke Energy
Bobby Moore	Duke Energy
Bradley Harris	Duke Energy
Brant Werts	Duke Energy
Brett Breitshwerdt	Duke Energy
Brian Bak	Duke Energy
Brian Lusher	Duke Energy
Bryan Dougherty	Duke Energy
Bryan Wright	Duke Energy
Camal Robinson	Duke Energy
Catherine Goza	Duke Energy
Chris Edge	Duke Energy
Chris Hixson	Duke Energy
Chris Nolan	Duke Energy
Christopher Sharpe	Duke Energy
Conitsha Barnes	Duke Energy
Dan Donochod	Duke Energy
Dan Sympson	Duke Energy
Danny Brothers	Duke Energy
David Johnson	Duke Energy
Dennis Turner	Duke Energy

Elaine Jordan	Duke Energy
Emilly Felt	Duke Energy
Emily DeRoberts	Duke Energy
Evan Shearer	Duke Energy
Felicia Diakite	Duke Energy
George Brown	Duke Energy
Glen Snider	Duke Energy
Grace Rountree	Duke Energy
Gray Tompson	Duke Energy
Hans Jacob	Duke Energy
Heather Shirley Smith	Duke Energy
Jack Jirak	Duke Energy
Jacob Colley	Duke Energy
James Wurst	Duke Energy
Jason Handley	Duke Energy
Jason Martin	Duke Energy
Jay Oliver	Duke Energy
Jeffery Cardwell	Duke Energy
Jeffrey Day	Duke Energy
Jennifer Canipe	Duke Energy
Jim Northrup	Duke Energy
Joe Glass	Duke Energy
Joe McCallister	Duke Energy
Jonathan Byrd	Duke Energy
Jonathan Landy	Duke Energy
Joseph Jacobs	Duke Energy
Joshua Paragas	Duke Energy
Justin Brown	Duke Energy
Justin LaRoche	Duke Energy
Keith Pike	Duke Energy
Kendal Bowman	Duke Energy

Kendrick Fentress	Duke Energy
Kenneth Jennings	Duke Energy
Kevin McLaughlin	Duke Energy
Ladawn Toon	Duke Energy
Lauren Tryonis	Duke Energy
Lee Mitchell	Duke Energy
Linda Hannon	Duke Energy
Lon Huber	Duke Energy
Mark McIntire	Duke Energy
Mark Oliver	Duke Energy
Mark Tabert	Duke Energy
Matt Kalemba	Duke Energy
Maura Farver	Duke Energy
Melanie Shipley	Duke Energy
Melissa Murphy	Duke Energy
Meredith Archie	Duke Energy
Michael PIrro	Duke Energy
Michael Rib	Duke Energy
Michele deLyon	Duke Energy
Mike Callahan	Duke Energy
Mike Quinto	Duke Energy
Mike Ruhe	Duke Energy
Nate Finucane	Duke Energy
Nathan Gagnon	Duke Energy
Nicholas Lalley	Duke Energy
Patrick Louka	Duke Energy
pedram Mohseni	Duke Energy
Phillip Stillman	Duke Energy
Precious Tullis	Duke Energy
Quinetta Buterbaugh	Duke Energy
Randall Heath	Duke Energy

Ravi Mujumdar	Duke Energy
Rebecca Dulin	Duke Energy
Rick Jiran	Duke Energy
Ronnie Young	Duke Energy
Ryan Boyle	Duke Energy
Ryan McAward	Duke Energy
Ryan Minto	Duke Energy
Ryan Mosier	Duke Energy
Sam Wellborn	Duke Energy
Sammy Roberts	Duke Energy
Sarah Adair	Duke Energy
Sarah Kutcher	Duke Energy
Stephen De May	Duke Energy
Steve Immel	Duke Energy
Susan Snow	Duke Energy
Terri Edwards	Duke Energy
Thomas Beatty	Duke Energy
Tim Duff	Duke Energy
Timika Shafeek-Horton	Duke Energy
Tom Davis	Duke Energy
Tyler Cook	Duke Energy
Zachary Evans	Duke Energy
Casey Collins	Duke University
Jason Elliott	Duke University
Russell Thompson	Duke University
Doug Heron	Duke University / DUHS
Wafa Khalil	Durham Climate Reality Project
Tobin Freid	Durham County Government
Brad Slocum	East Point Energy
Harris Vaughan	Eckel & Vaughan
Jevonte Blount	Eckel & Vaughan

Tori Ludwig	Eckel & Vaughan
Seth Studer	Ecoplexus
Ed Ablard	Ed Ablard Law Firm
Mike Smith	Electric Cooperatives of South Carolina
Neil Kern	Electric Power Research Institute
Tracy Leslie	Electric Power Research Institute
Adam Diamant	Electric Power Research Institute, Energy & Environmental Analysis Program
Andrew Fusco	ElectriCities of North Carolina, Inc.
Drew Elliot	ElectriCities of North Carolina, Inc.
Kathy Moyer	ElectriCities of North Carolina, Inc.
Shelby Green	Energy and Policy Institute
Alex DeGolia	Environmental Defense Fund
David Kelly	Environmental Defense Fund
Drew Stilson	Environmental Defense Fund
Michelle Allen	Environmental Defense Fund
Tom Cunningham	Equinor Renewables
Aram Zamgochian	ESS Tech, Inc.
Dennis Derricks	Facebook
Keith Lynch	Fayetteville Public Works Commission
Morgan Hylton	Fayetteville Public Works Commission
Ben Snowden	Fox Rothschild
Gray Styers	Fox Rothschild
Karen Kemerait	Fox Rothschild
Taylor Speer	Fox Rothschild
Holly Garrett	Gaia Herbs
Amy Wallace	GE Power
Brian Smith	GE Power

Brittany Stinson	GE Power
Edwin Wu	GE Power
James Fazzone	GE Power
Justin Seymour	GE Power
Donna Robichaud	Geenex Solar LLC
Lesley Williams	Geenex Solar LLC
Ethan Blumenthal	Good Solar Organization
Jamey Goldin	Google, LLC
Alissa Bemis	Great Plains Institute
Doug Scott	Great Plains Institute
Trevor Drake	Great Plains Institute
Brad Rouse	Green Built Alliance / Energy Savers Network
William McNeil	Greensboro Solar Power Now Coalition
Ann Thompson	Guidehouse
Chip Wood	Guidehouse
Curt Anderson	Guidehouse
Dan Bradley	Guidehouse
Danielle Vitoff	Guidehouse
Jamie Bond	Guidehouse
Jennifer Ahearn	Guidehouse
Latisha Younger-Canon	Guidehouse
Shalom Goffri	Guidehouse
Tom Batchelor	Haywood EMC
Krystal Harwick	HDR Inc.
Russell Outcalt	Interfaith Creation Care of the Triangle
Erin Curran	Invenergy
Kaley Bangston	Invenergy
Jean Pudlo	JB Pudlo Consulting
Bryan Thomas	JLL

Betsy McCorkle	Kairos Government Affairs
Bill Cummings	Kimberly-Clark Corporation
Nelson Freeman	KTS Strategies LLC
Brian Pattillo	Lockhart Power Company
James Seay	Lockhart Power Company
Kevin Hutchison	Longroad Energy
Andrea Kells	McGuireWoods LLP
Kristin Athens	McGuireWoods LLP
Tess Rogers	McGuireWoods LLP
Tracy DeMarco	McGuireWoods LLP
Anne Lazarides	Member of the public
Caleb Rudow	Member of the public
Marcia Vetter	Member of the public
Rosemary Robinson	Member of the public
Bill Dam	Member of the public - Environmental scientist
Steven Castracane	Messer
Brad Ikenberry	Michelin North America
Daniel Sistrunk	Milliken & Company
Joseph Sticca	Mitsubishi Power Americas
Julie Mayfield	MountainTrue
Benjamin Smith	National Council of Structural Engineers Associations
Amanda Levin	Natural Resources Defense Council
Irene Nielson	Natural Resources Defense Council
John Thigpen	Natural Resources Defense Council
Luis Martinez	Natural Resources Defense Council
Samuel Whillans	Natural Resources Defense Council
Keval Kaur Khalsa	NC WARN
Sally Robertson	NC WARN
Bob Hinton	NCUC - Public Staff
Chris Ayers	NCUC - Public Staff

David Williamson	NCUC - Public Staff
Dianna Downey	NCUC - Public Staff
Dustin Metz	NCUC - Public Staff
Evan Lawrence	NCUC - Public Staff
James McLawhorn	NCUC - Public Staff
Jay Lucas	NCUC - Public Staff
Jeff Thomas	NCUC - Public Staff
Jim Singer	NCUC - Public Staff
Jordan Nader	NCUC - Public Staff
Jordan Pappas	NCUC - Public Staff
June Chiu	NCUC - Public Staff
Layla Cummings	NCUC - Public Staff
Lucy Edmondson	NCUC - Public Staff
Michael Maness	NCUC - Public Staff
Munashe Magarira	NCUC - Public Staff
Nadia Luhr	NCUC - Public Staff
Phat Tran	NCUC - Public Staff
Robert Josey	NCUC - Public Staff
Scott Saillor	NCUC - Public Staff
Tommy Williamson	NCUC - Public Staff
William Zeke Creech	NCUC - Public Staff
Sarah Fraser	New Belgium Brewing
Naomi Hodges	North Carolina Black Alliance
Christina Kopitopoulou	North Carolina Clean Energy Technology Center
Grady O'Brien	North Carolina Conservation Network
Will Scott	North Carolina Conservation Network
Jennifer Mundt	North Carolina Department of Commerce

Michelle Boswell	North Carolina Department of Commerce
Neha Patel	North Carolina Department of Commerce
Robert Bennett	North Carolina Department of Environmental Quality
Francisco Benzoni	North Carolina Department of Justice
Margaret Force	North Carolina Department of Justice
Teresa Townsend	North Carolina Department of Justice
Tiffany Lucas	North Carolina Department of Justice
Michael Abraczinskas	North Carolina Division of Air Quality
Randy Strait	North Carolina Division of Air Quality/North Carolina Department of Environmental Quality
Charles Bayless	North Carolina Electric Membership Corporation
Deborah Britt	North Carolina Electric Membership Corporation
James Musilek	North Carolina Electric Membership Corporation
John Cook	North Carolina Electric Membership Corporation
Khalil Porter	North Carolina Electric Membership Corporation
Michael Youth	North Carolina Electric Membership Corporation
Richard McCall	North Carolina Electric Membership Corporation
Robert Beadle	North Carolina Electric Membership Corporation

Tim Dodge	North Carolina Electric Membership Corporation
DeAndrea Salvador	North Carolina General Assembly
Gary Smith	North Carolina Interfaith Power and Light
Penny Hooper	North Carolina Interfaith Power and Light
Stephen Jurovics	North Carolina Interfaith Power and Light
Alfred Ripley	North Carolina Justice Center
Claire Williamson	North Carolina Justice Center
Robin Smith	North Carolina League of Conservation Voters
Ross Smith	North Carolina Manufacturers Alliance
Kathie Dello	North Carolina State University
Peter Ledford	North Carolina Sustainable Energy Association
Nicole Hensley	North Carolina's Electric Cooperatives
Kevin ODonnell	Nova Energy Consultants, Inc.
Hayes Framme	Orsted
Patrick Ballantine	Orsted
Skylar Drennen	Orsted
Scott Bragg	PactivEvergreen
Mark Mirabito	Palladium Energy
Ryan Ledonne	Palladium Energy
Randy Doyle	Parkdale Mills
Katherine Ross	Parker Poe
Gordon Powell	Person County Commissioner
Jessica Rowe	Piedmont Environmental Alliance
Adam Stein	Pine Gate Renewables, LLC
Steven Levitas	Pine Gate Renewables, LLC

Jessica Shipley	Regulatory Assistance Project
Gennelle Wilson	RMI
Kirsten Millar	RMI
Julie Robinson	Robinson Consulting Group
Tommy Chapman	Rutherford Electric Membership Corporation
Alexandra St. Pe	RWE Renewables
Evan Racine-Johnson	RWE Renewables
James Sun	RWE Renewables
Kate Mckeever	RWE Renewables
Ross Barnhardt	Sands Law, PLLC
Sandy Sands	Sands Law, PLLC
Geoff Penland	Santee Cooper
Will Brown	Santee Cooper
Matt Hooper	Savion
Steven Courtney	ScottMadden, Inc.
Mike Woodard	Senate
Christopher Clement	Siemens Energy
Kelly Melton	Siemens Energy
Cassie Gavin	Sierra Club
David Rogers	Sierra Club
Leah Cooper	Sierra Nevada Brewing Co.
Daisy Chung	Smart Electric Power Alliance
Jared Leader	Smart Electric Power Alliance
Sharon Allan	Smart Electric Power Alliance
Sid Shah	Soltage, LLC
Stephanie Sienkowski	Soltage, LLC
Dennis Richter	Solterra Partners, LLC
Ben Garris	South Carolina Coastal Conservation League
Chantal Fryer	South Carolina Department of Commerce

Connor Parker	South Carolina Department of Consumer Affairs
Eliza Mecaj	South Carolina Department of Consumer Affairs
Joan Williams	South Carolina Department of Consumer Affairs
Roger Hall	South Carolina Dept of Consumer Affairs
Anthony Sandonato	South Carolina Office of Regulatory Staff
Dawn Hipp	South Carolina Office of Regulatory Staff
Robert Lawyer	South Carolina Office of Regulatory Staff
Stacey Washington	South Carolina Office of Regulatory Staff
Ann Livingston	Southeast Sustainability Directors Network
Jaime Simmons	Southeastern Wind Coalition
Karly Lohan	Southeastern Wind Coalition
Katharine Kollins	Southeastern Wind Coalition
Bryan Jacob	Southern Alliance for Clean Energy
Forest Bradley Wright	Southern Alliance for Clean Energy
Maggie Shober	Southern Alliance for Clean Energy
Hamilton Davis	Southern Current LLC
David Neal	Southern Environmental Law Center
Gudrun Thompson	Southern Environmental Law Center
Lauren Bowen	Southern Environmental Law Center
Nicholas Jimenez	Southern Environmental Law Center
Tirrill Moore	Southern Environmental Law Center
Simon Mahan	Southern Renewable Energy Association
Dionne Delli-Gatti	State of North Carolina

Brian Herndon	Strata Clean Energy
Marshall Conrad	Strata Clean Energy
Edward Burgess	Strategen Consulting
Thad Culley	Sunrun Inc.
Rachel Wilson	Synapse Energy Economics
Tyler Fitch	Synapse Energy Economics
Christopher Fendley	TerraPower
David Penskar	TerraPower
Thomas Caggiano	The Nature Conservancy
Sammy Fretwell	The State Media Co./ McClatchy
George Santucci	Town of Boone
John Richardson	Town of Chapel Hill
Jonas Monast	UNC School of Law
Michael Coleman	Upstate Forever
Chip Estes	UTILICOM
Jackson Freeman	Vestas North Americas
Lindsey Hallock	Vote Solar
Bhawramaett Broehm	Wartsila
Russell Weeks	Wartsila
Will Lange	WaterFurnance
*There were an additional 32 participants who called in by phone that are not listed here as Zoom Webinar cannot capture the names of dial-in attendees.	

ATTACHMENT 2

Duke Energy Carolinas Carbon Plan Stakeholder Meeting 1

Virtual Meeting – January 25, 2022

**Please note, this meeting is being recorded. Presentations will be posted on the Carolinas Carbon Plan website, and discussion portions will be kept for internal purposes only to ensure accuracy of meeting notes.*

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Today’s Approach

Part 1:
Overview & Key Considerations

The morning session will be focused on introductions, process, level-setting and core objectives of the Carolinas Carbon Plan.

Part 2:
Inputs & Assumptions

The afternoon session will provide an opportunity to provide feedback to the technical inputs and assumptions that drive the modeling underlying the Carbon Plan

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Great Plains Institute (GPI)

Doug Scott,
Vice President, Electricity & Efficiency

Trevor Drake,
Senior Program Manager

Alissa Bemis,
Meeting & Administrative Coordinator

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Related GPI Work

- Integrated Resource Planning
- Power Plant Host Community Impacts
- Time-Varying Rate Designs
- Electric Vehicle Investments and Programs
- Distribution System Planning
- Load Flexibility and Demand Response Programs
- Utility Performance Metrics

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Duke Welcome

Stephen De May
State President, North Carolina

Mike Callahan
State President, South Carolina

Stakeholder Process Objectives

1. Ensure the Carolinas Carbon Plan is informed by input from a wide range of stakeholders.

2. Enable a transparent conversation about how to plan an energy transition that prioritizes affordability and reliability for NC and SC customers.

3. Build on areas of agreement, clarify areas of disagreement, and seek opportunities for collaboration in advance of filing the Carolinas Carbon Plan.

Stakeholder Process Timeline

Stakeholder Engagement

Jan. 25

Feb. 23

March 22

Proposed Plan Development

Finalized Proposed Plan

Supplemental Engagement

Carolinas Carbon Plan

January – March

April – Mid-May

Mid-May - December

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Meeting Ground Rules

- **Respect each other:** Help us to collectively uphold respect for each other's experiences and opinions, even in difficult conversations. We need everyone's wisdom to achieve better understanding and develop robust solutions.

- **Focus on values and outcomes:** Today's discussion is about what stakeholders value in the energy future, and how the Carolinas Carbon Plan can align with those values. Pending legal issues are outside the scope of this conversation.

- **Chatham House Rule**: Empower others to voice their perspective by respecting the "Chatham House Rule;" you are welcome to share information discussed, but not a participant's identity or affiliation (including unapproved recording of this session).

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Meeting Ground Rules

- **Respect the time:** Our time together is limited and valuable, and we have a large group, so please be mindful of the time and of others' opportunity to participate.

- **Use the chat:** Please submit your comments and questions in the chat. GPI staff will monitor the chat to pull out questions for Q&A portions. Please be respectful and focus on issues, not people.

- **Raise your hand:** During dedicated Q&A portions of the meeting, use the "Raise Hand" feature to indicate you would like to voice a question or comment.

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Meeting Dates

1. Tuesday, January 25^{th}
2. Wednesday, February 23^{rd}
3. Tuesday, March 22^{nd}

Future meeting agendas will be based on feedback received today

Additional Participation

Meeting materials/recordings will be uploaded to the website:

www.duke-energy.com/CarolinasCarbonPlan

Information/feedback can be sent to:

DukeCarbonPlan@gpisd.net

Meeting recordings (Q&A portions of meetings will be removed to adhere to the non-attribution rule) and meeting summaries will be uploaded to the website for participants to access.

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Today’s Agenda

Part 1: Overview and Key Considerations

9:00am:	**Welcome and Introductions**
9:15am:	**Stakeholder Engagement Process and Objectives**
9:45am:	**Introduction to Resource Planning and Decarbonization in the Carolinas**
10:15am:	**Road to 70% Emissions Reduction and Net-Zero Future**
10:45am:	**BREAK**
11:00am	**Discussion**
12:00pm	**LUNCH BREAK**

Part 2: Modeling Inputs and Assumptions

1:00pm	**Introduction to Modeling**
1:30pm	**Economic Coal Retirements Modeling Methodology**
2:00pm	**Load Forecast: Key Drivers**
2:45pm	**BREAK**
3:00pm	**Other Key Modeling Assumptions:**

- Solar Interconnection Forecast
- Technology Forecasts
- Natural Gas Price Forecast

3:45pm	**Next Steps**
4:00pm	**Adjourn**

Introduction to Resource Planning and Decarbonization in the Carolinas

Glen Snider, Managing Director, Carolinas Integrated Resource Planning

JANUARY 25, 2022

DUKE ENERGY®

BUILDING A SMARTER ENERGY FUTURE®

Guiding Principles for Decarbonization: Sustainability, Affordability, Reliability

Sustainability

- Carbon reduction targets
  - 70% reduction 2030
  - Net zero by 2050
- Continually reducing environmental impact to ensure
  - Cleaner air
  - Cleaner water
  - Cleaner land

Affordability

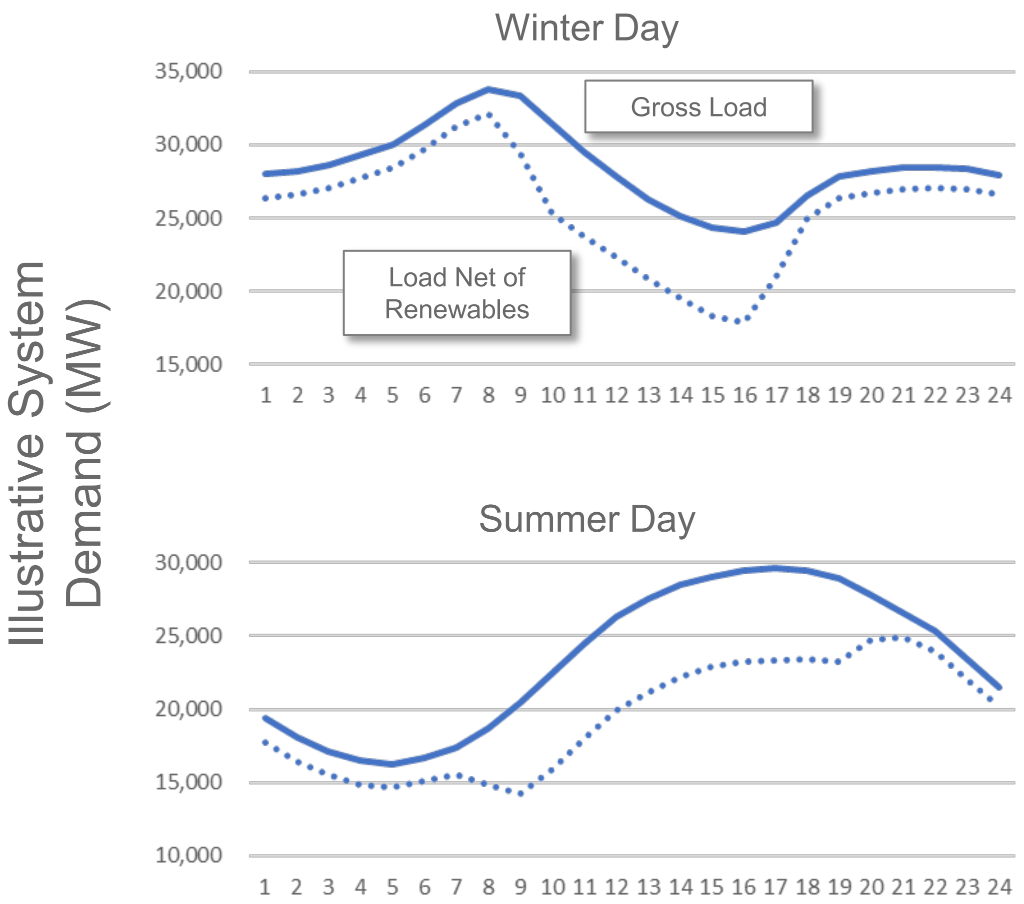
- Capital, land, operations and maintenance (O&M), and fuel costs vary by resource type
- Cumulative costs over time represented as present value of costs
- Evaluation of forecasted annual bill impacts shows costs & benefits at snapshots in time

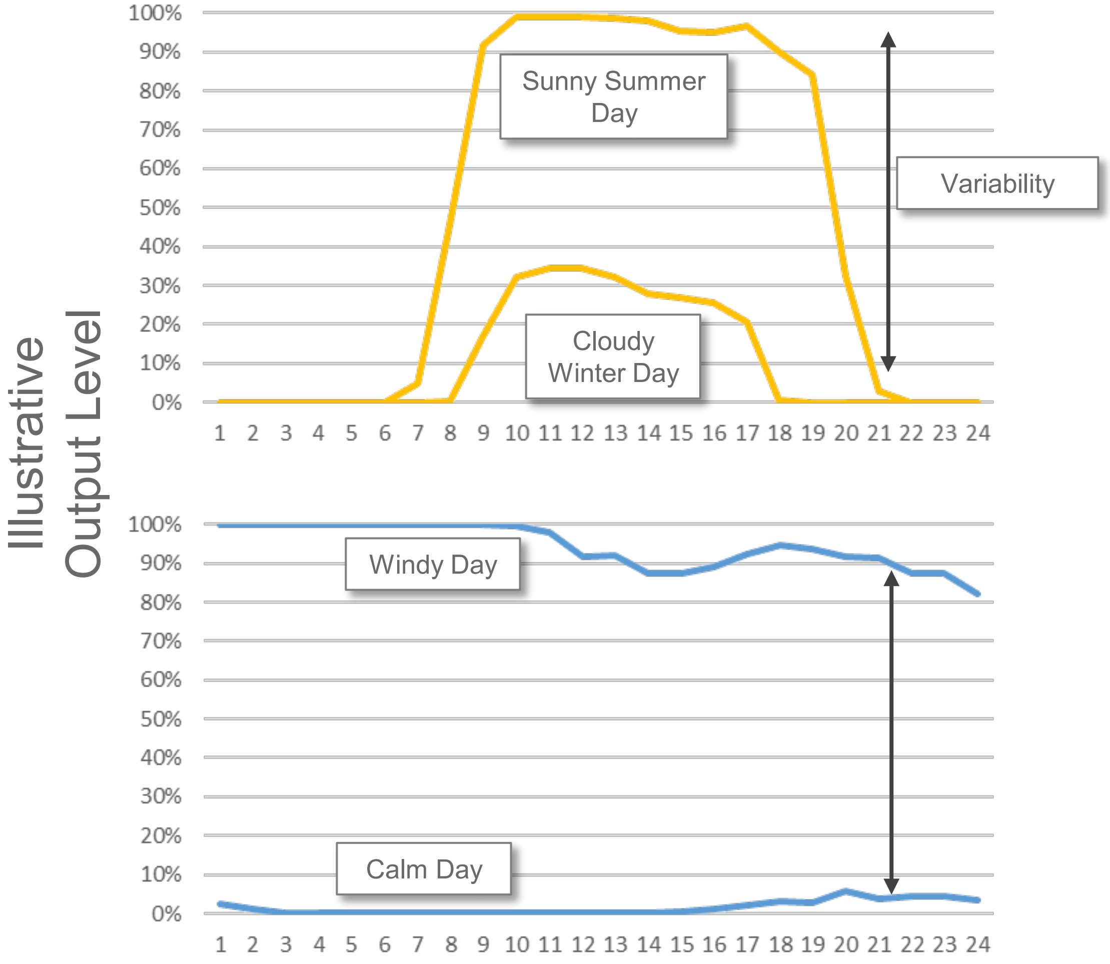
Reliability

- Serve customer demand that varies year-to-year, month-to-month, hour-to-hour, and minute-to-minute
- Maintain adequate long-term reserves to meet customer needs during peak demand periods
- Maintain adequate system flexibility to respond to changing real-time operating conditions

Reliability Requires Responding to Variability

- Variable generation compounds challenges of variable load, increasing importance of resources able to rapidly increase or decrease output to balance supply and demand in real time





Elements of Decarbonization

Shrink the Challenge	Grid Edge & Customer Programs	Load Reduction, Modification
Add Carbon-Free Resources	Renewables	Advanced Technologies
Ensure Reliability	Dispatchable Resources	Energy Storage

Executing a Plan Within a Plan

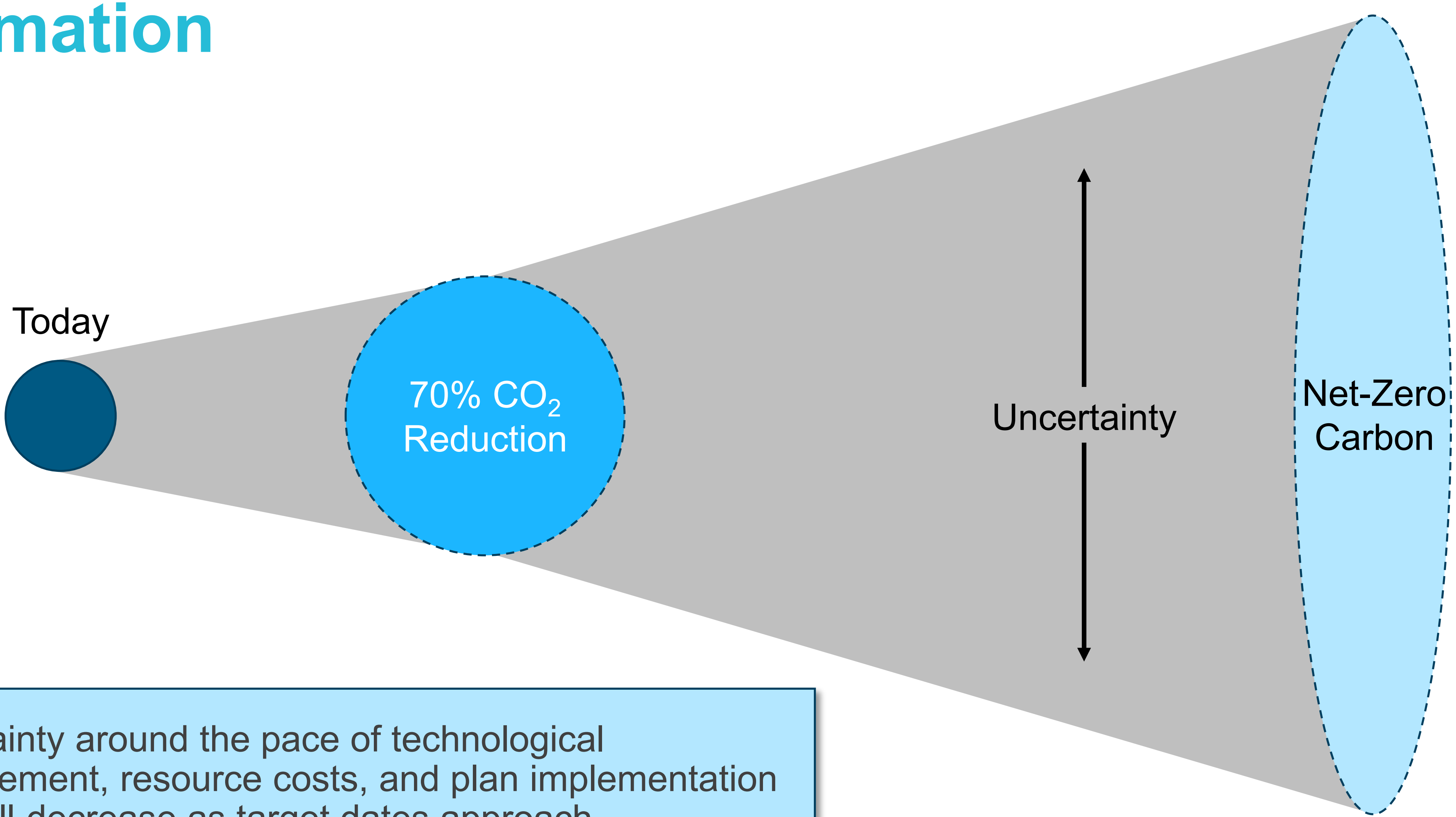
70% CO_2 Reduction → **Carbon Neutrality**

- Available Technologies
- Near-term Execution
- Supporting Actions to Enable Implementation

- Deployment of New Resource Types
- Advanced Nuclear
- Offshore Wind

- Emerging Technologies
- Preparation for Future Action
  - Research & Development
  - Technology Pilots
- Signposts Indicating Pace of Advancement

Periodic Carbon Plan Updates Will Incorporate New Information



Uncertainty around the pace of technological advancement, resource costs, and plan implementation risks will decrease as target dates approach

Road to 70% Emissions Reduction and Net-Zero Future

Mark McIntire, Director, Government and Environmental Affairs

Mike Quinto, Integrated Resource Planning, Lead Engineer

JANUARY 25, 2022

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Requirements for CO_2 Emissions Reduction

- ✓70% Reduction in Emissions
- ✓Of Carbon Dioxide (CO_2)
- ✓Emitted in the State (NC)
- ✓From electric generating facilities owned or operated by (or on behalf of) electric public utilities
- ✓From 2005
- ✓Carbon Neutrality by 2050

CO_2 Emissions Data Considerations

Publicly Available

Credible

Reliable

Repeatable

EPA eGRID

- Environmental Protection Agency (EPA) Emissions and Generation Resource Integrated Database (eGRID)

"The Emissions & Generation Resource Integrated Database (eGRID) is a comprehensive source of data on the environmental characteristics of almost all electric power generated in the United States. The preeminent source of emissions data for the electric power sector, eGRID is based on available plant-specific data for all U.S. electricity generating plants that provide power to the electric grid and report data to the U.S. government" – eGRID Technical Guide

- Used for environmental disclosures, emission inventories, and RPS and RECs Tracking

- Used by Federal Government, state and local governments, the EPA, National Labs, ISOs, non-governmental organizations, academia, and companies

eGRID Emissions Data Sources

- eGRID uses EPA's Clean Air Market Division (CAMD) Power Sector Emissions Data
  - Data reported to EPA by electric generating units to comply with the regulations in 40 CFR Part 75 and 40 CFR Part 63
    - Emissions data primarily uses Emissions Tracking Systems (ETS)/Continuous Emissions Monitoring Systems (CEMS)
      - Actual measurements of CO_2 in stack emissions
    - Where CEMS data is not available, eGRID uses EIA reported fuel data (EIA-923) to estimate emissions
      - Estimates emissions based on fuel consumed and standard emissions based on fuel type

CO_2 Emissions included in Baseline and Reduction Goals

Owned

Operated by

Operated on behalf of

CO_2 Emissions included in Baseline and Future Actual Emissions

Owned

Stack emissions associated with the ownership share of electric generation facilities located in North Carolina owned by DEC/DEP

Operated by

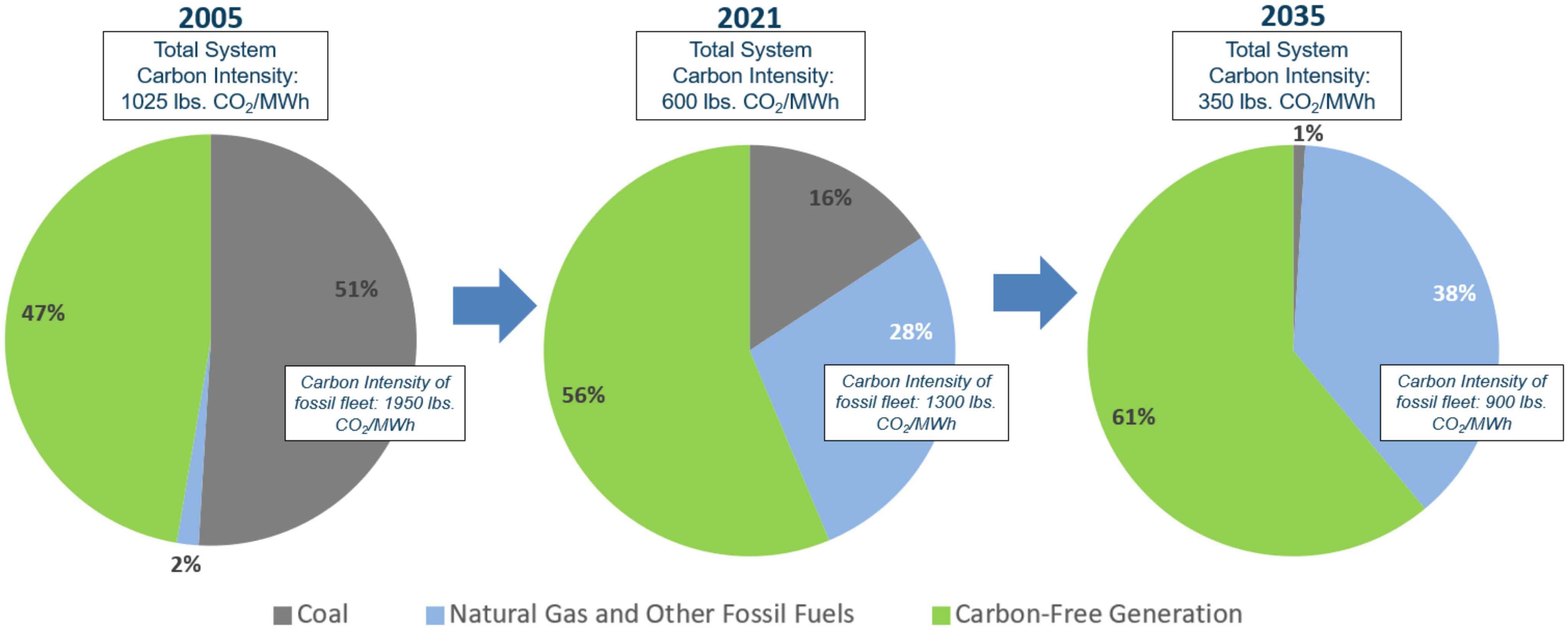
Stack emissions associated with electric generating facilities located in North Carolina operated by DEC/DEP

Operated on behalf of

Stack emissions associated with electric generating facilities located in North Carolina not owned or operated by DEC/DEP, but contracted to sell electrical output to DEC/DEP

Carolinas Combined Fleet Transition Progress

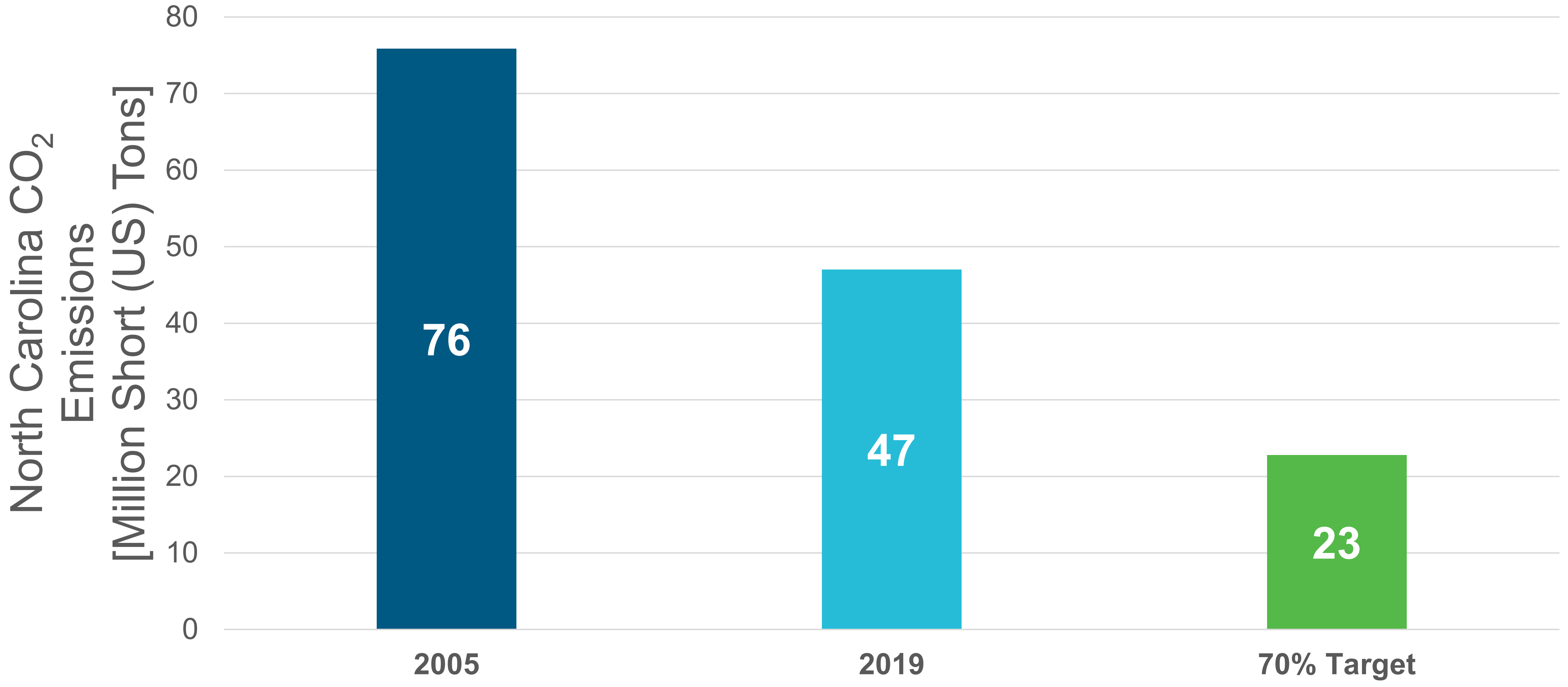
The combined DEC/DEP fleet is a national leader in low carbon intensity energy, with a current rate 37% lower than the industry average of 957 lbs. CO_2/MWh[1]



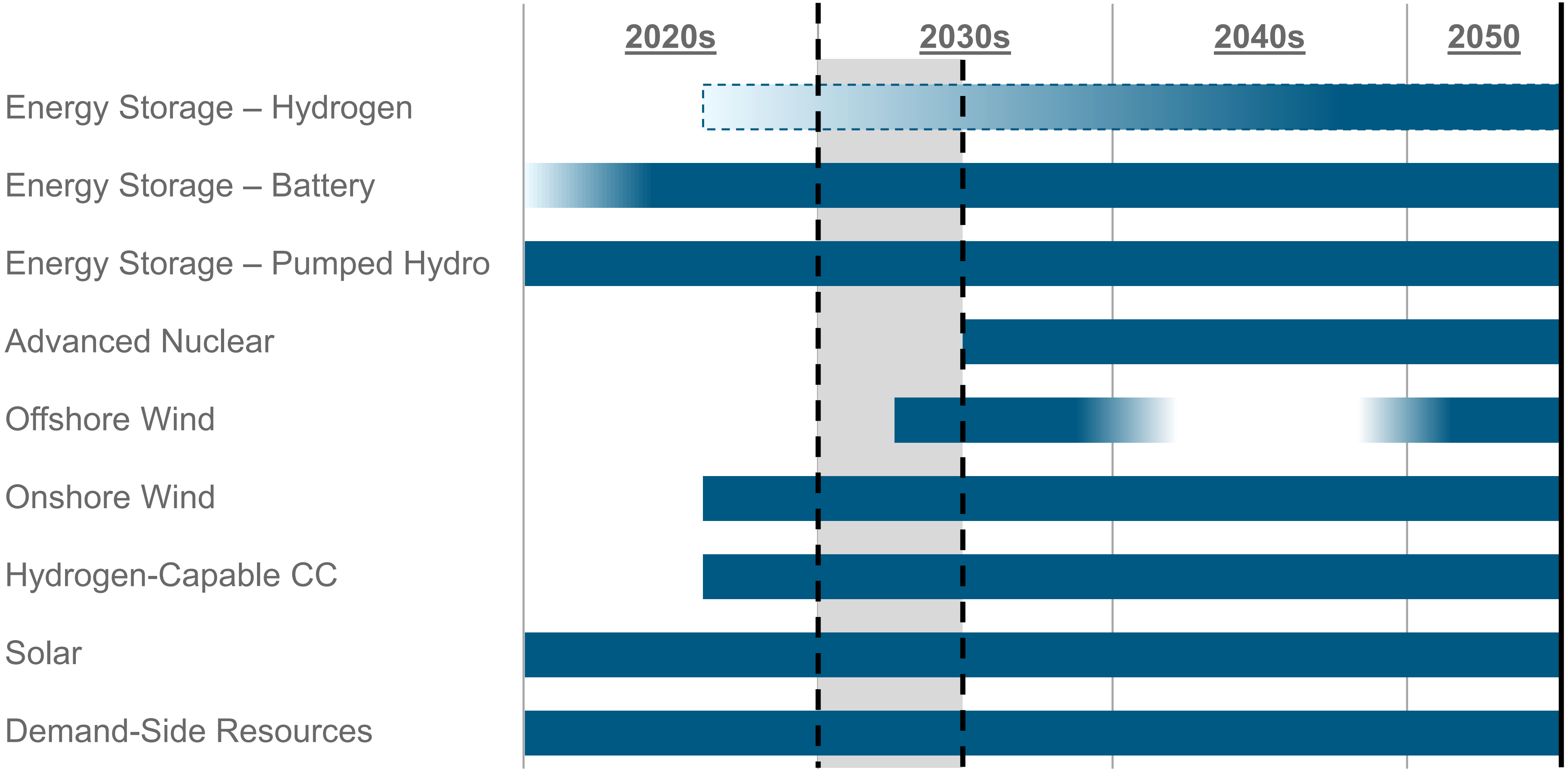
1Source: MJ Bradley, "Benchmarking Air Emissions of the 100 Largest Electric Power Producers in the United States" – July 2020, p. 30

Note: 2021 and 2035 energy mix and carbon intensity projections are based on the 2020 IRP Base w/ Carbon Policy

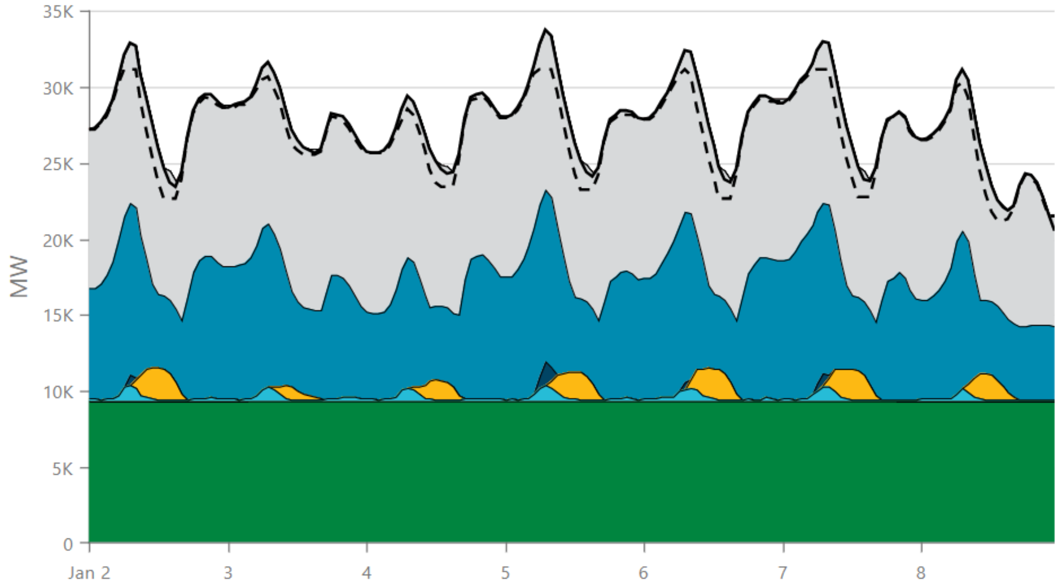
CO_2 Emissions Baseline, Progress, and 70% Reduction Target

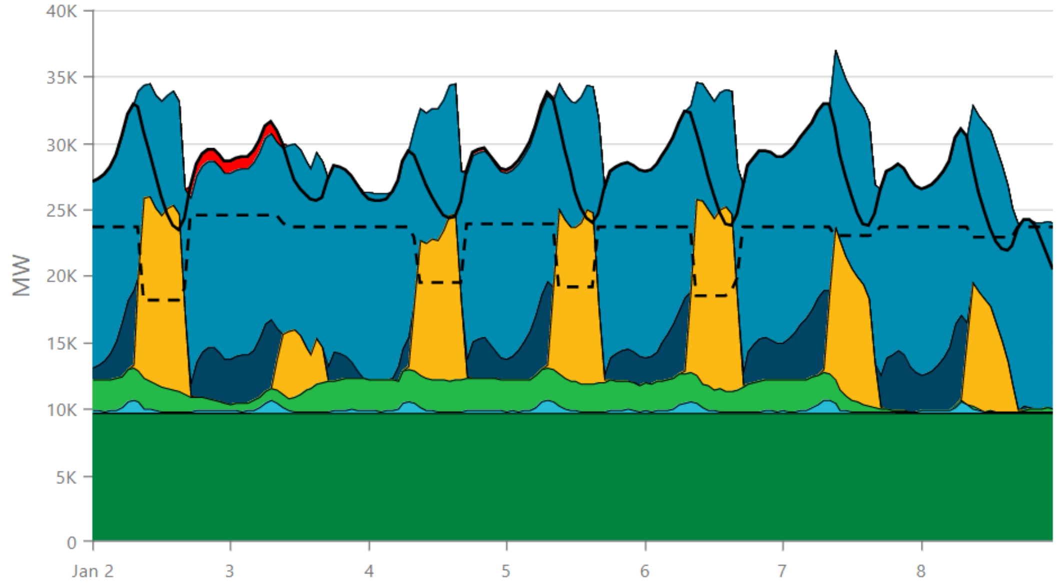


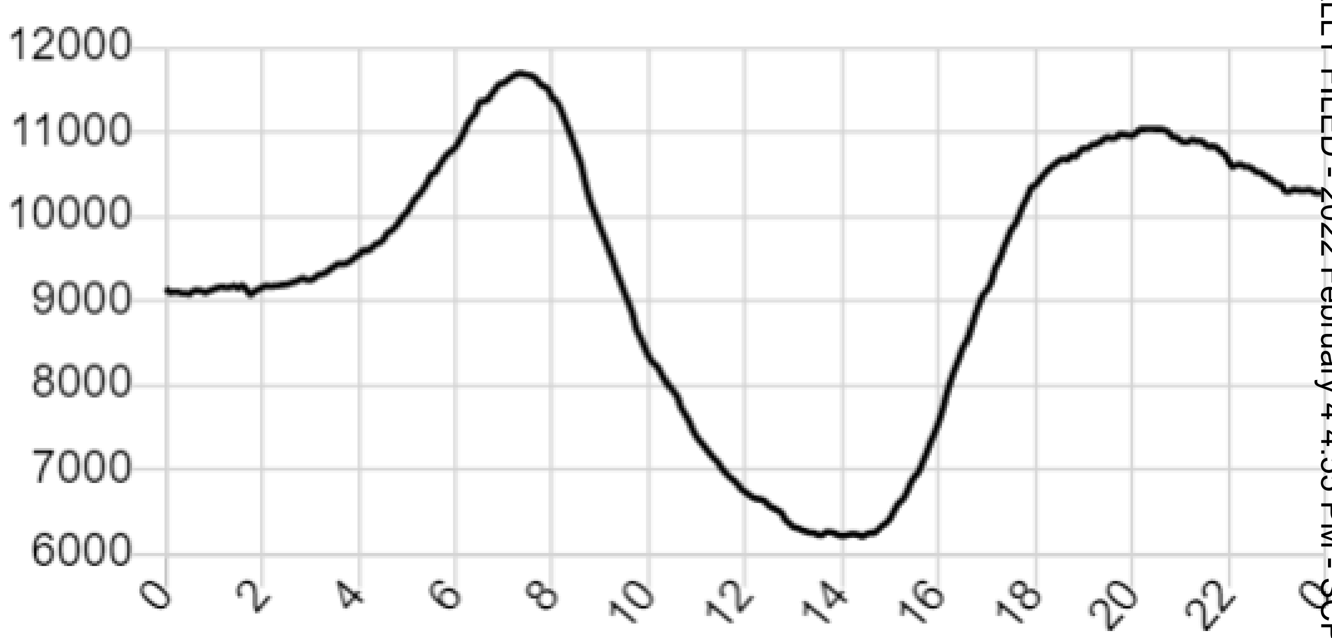
Decarbonization Replacement Resources



The NC/SC System Must be Built Preserving Reliability







- Net Load
- Load (2018)
- Curtailment
- Unserved
- New Demand Response
- Imports (Fossil)
- Coal
- Gas
- Storage
- Solar+Storage
- Solar
- Wind
- Hydropower
- Nuclear

Break

Please return at 11:05AM.

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Clarifying Questions

What information would help you better understand the content presented this morning?

Discussion:

What are your criteria for a successful carbon plan?

Lunch Break

Please return at 1:00PM.

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Introduction to Modeling

Bobby McMurry, Director, Production Cost Modeling & Analytics

JANUARY 25, 2022

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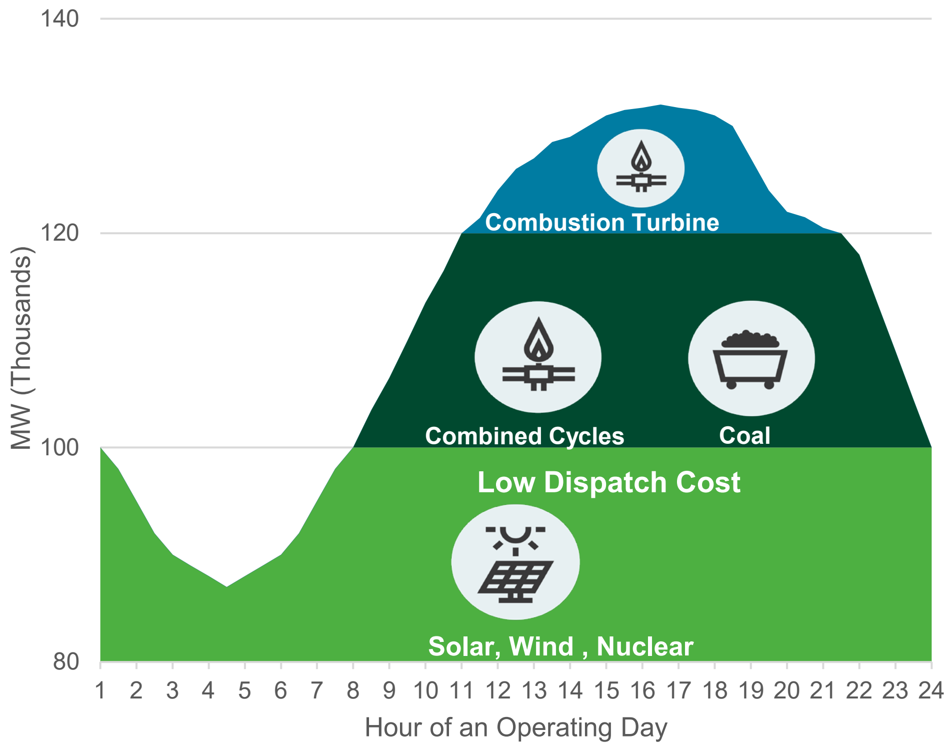
Models, Inputs and Assumptions

In-depth Modeling Simulates the Power System Operations Over Time

- Capacity expansion modeling optimizes the set of resources between existing and new generation sources over long timeframe
    - Expansion tools consider the fit of resource to the type of demand: Is it needed every hour? Is it needed occasionally over the year? Is it only needed as load goes above a certain level?
- Production cost modeling optimizes the use of resources in hourly, seasonal, and annual complexities of actual power systems



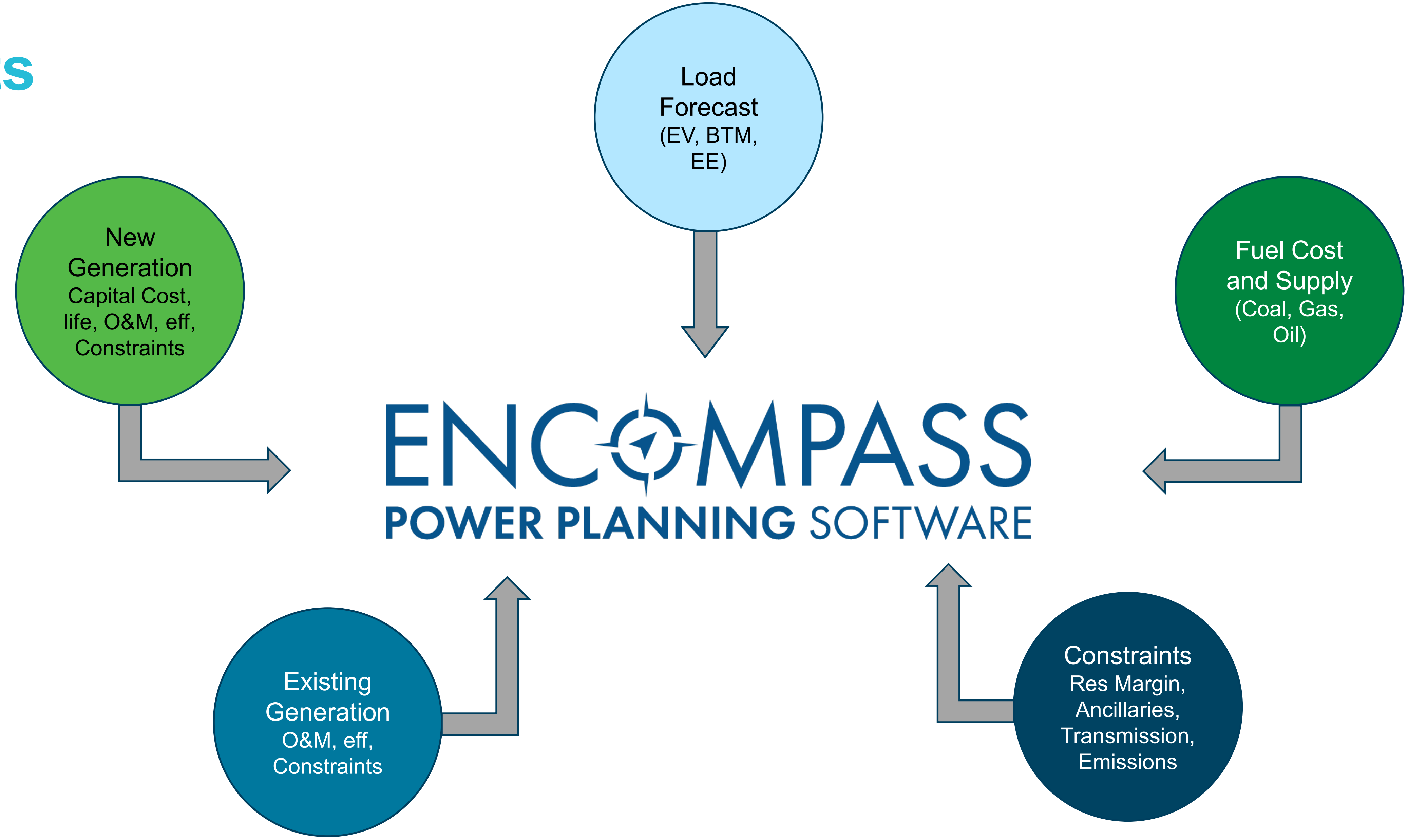
Models

ANCHOR POWER SOLUTIONS

- EnCompass Power Planning Software
  - New Capacity Expansion, Production Cost and Regional Power Flow Model
    - Integration – 2020 and 2021
    - Advantages
    - Mixed Integer Linear Programing – model all constraints at the same time
      - Unlimited Ancillaries
      - Emission Caps
      - Specific Renewable Requirement
      - Reserve margin – monthly
      - Advanced storage logic
      - Dual Fuel Optimization
      - Economic Retirement

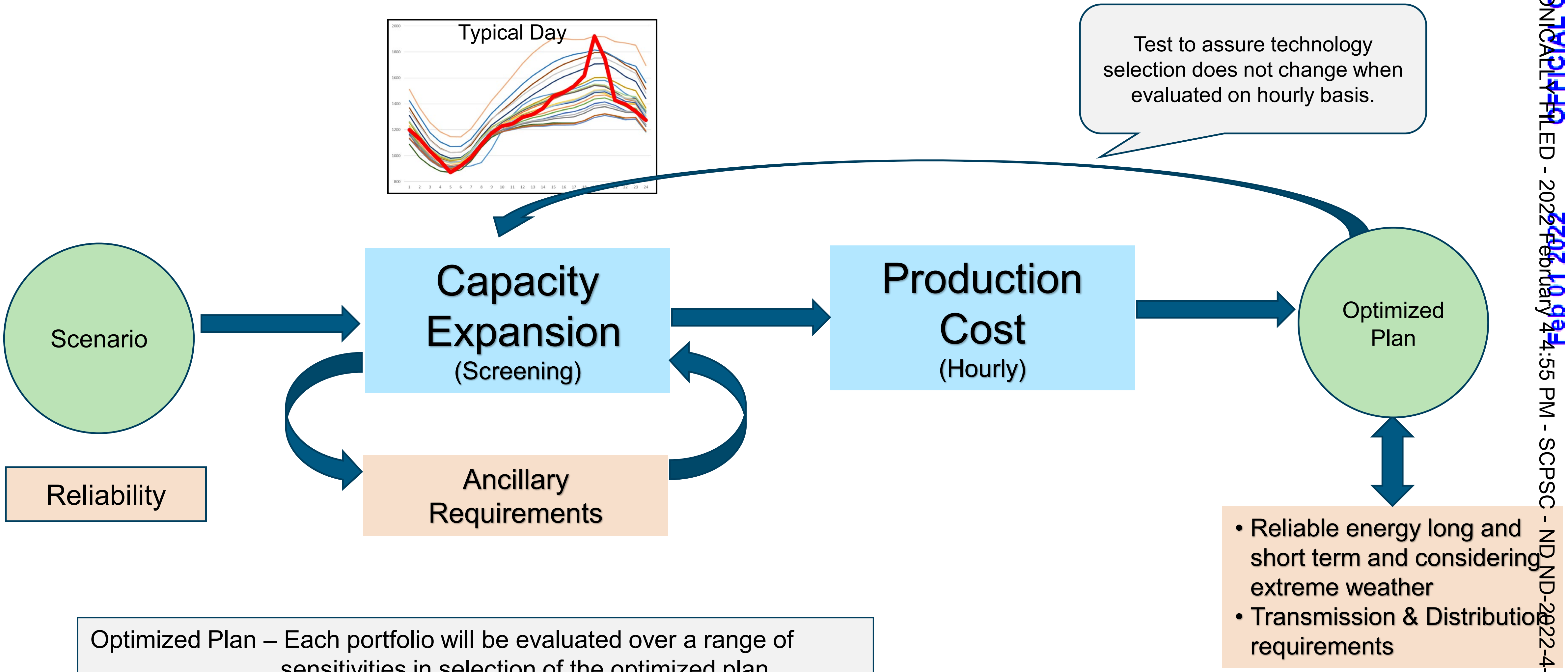
- Reliability
  - Regulating & Balancing Reserves (Ancillaries) – Provides reserves needed to account for day ahead forecast changes and inter-hour volatility
  - SERVM – Reliability check to assure portfolios will not exceed 1 loss of load event per 10-year period
    - SERVM = Strategic Energy & Risk Valuation Model

Inputs



Load Forecast (EV, BTM, EE)
New Generation Capital Cost, life, O&M, eff, Constraints
Fuel Cost and Supply (Coal, Gas, Oil)
ENCOMPASS
POWER PLANNING SOFTWARE
Existing Generation O&M, eff, Constraints
Constraints Res Margin, Ancillaries, Transmission, Emissions

Reliability & Affordability Require Detailed Modeling



Optimized Plan – Each portfolio will be evaluated over a range of sensitivities in selection of the optimized plan.

- Load, Fuel, Emissions cap, Technology Cost, Financial impact

Q&A

Coal Retirements Modeling Methodology

Mike Quinto, Integrated Resource Planning, Lead Engineer

JANUARY 25, 2022

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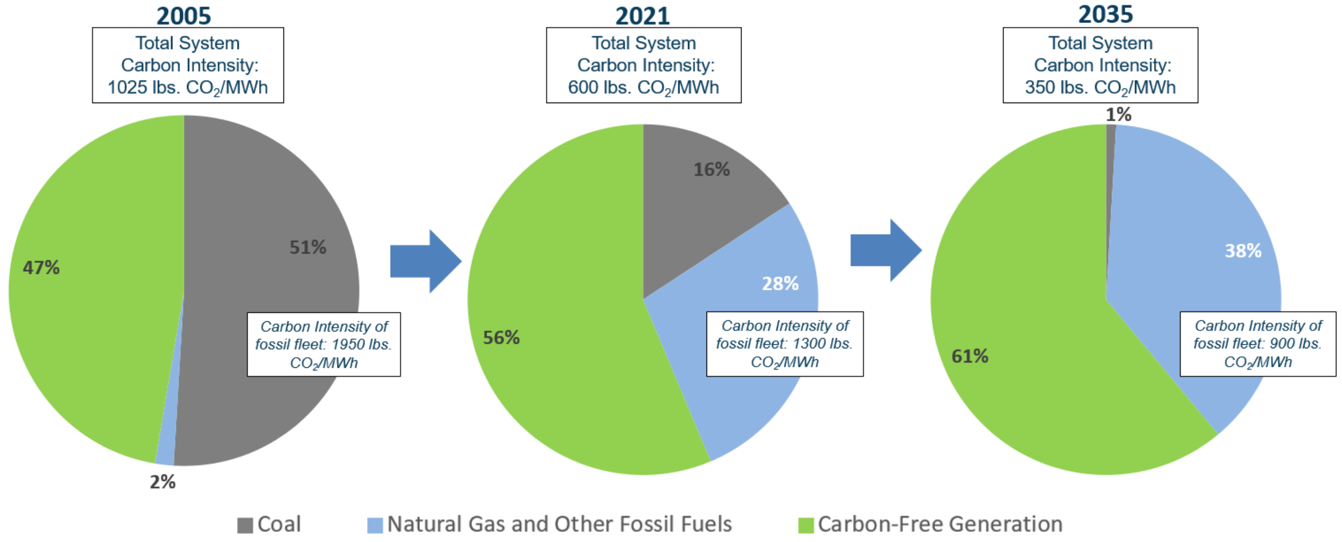
Coal in the Carolinas (as of 2020 IRP)

- Coal assets in the DEC and DEP fleet have provided reliable capacity and energy to customers for decades
- Remaining coal assets continue to provide year-round dispatchability that is especially critical during high load winter conditions
- As the industry landscape changes and market forces drive down costs of replacement resources, it is important to develop a transition plan that recognizes where replacement resources become more economic and carry less risk for customers

The combined DEC/DEP fleet is a national leader in low carbon intensity energy, with a current rate 37% lower than the industry average of 957 lbs. CO_2/MWh[1]



1Source: MJ Bradley, "Benchmarking Air Emissions of the 100 Largest Electric Power Producers in the United States" – July 2020, p. 30

*2021 and 2035 data reflects projections from 2020 DEC/DEP IRP Base Case with Carbon Policy – 2022 Carbon Plan will update this analysis

Coal Retirement Analysis Background

- Previous IRPs utilized the retirement dates of coal units consistent with DEC/DEP's most recently approved depreciation study
- Economic coal retirement analysis was performed as a part of the 2020 IRPs
- Coal retirement analysis methodology was a topic in the NCUC's Second Technical Conference in the 2020 IRP
- Analysis in the 2020 IRPs and the methodologies presented in the Second Technical Conference lay the foundation to refine retirement analysis in support of carbon reduction targets in the new legislation
- Coal retirement analysis will be refined and incorporated into Carbon Plan

Retirement Analysis

Existing Capacity Costs:

- Incremental Maintenance CapEx
- Ongoing Fixed O&M
- Environmental Compliance CapEx
- System Production Cost Value

Replacement Capacity Costs:

- New Generation CapEx
- New Fixed O&M
- Retiring & New Generation Transmission CapEx
- System Production Cost Value

When a unit is retired and **what** it is replaced can change the inputs and balance of this equation

DEC/DEP Coal Fleet Statistics

Unit	Fuel Capabilities	Maximum Natural Gas Co-firing Capability	Unit Capacity (Winter)	Unit Capacity (Summer)	In-Service Date	2020 IRP Economic Coal Retirement Analysis Retirement Date (YE)	Current Depreciation Study "Probable Retirement Year" (YE)
Allen 1	Coal		167	162	1957	2023	2024
Allen 5	Coal		259	259	1961	2023	2026
Cliffside 5	Coal/Gas	40%	546	544	1972	2025	2032
Roxboro 3	Coal		698	694	1973	2027	2033
Roxboro 4	Coal		711	698	1980	2027	2033
Roxboro 1	Coal		380	379	1966	2028	2028
Roxboro 2	Coal		673	668	1968	2028	2028
Mayo 1	Coal		713	704	1983	2028	2035
Marshall 1	Coal/Gas	40%	380	370	1965	2034	2034
Marshall 2	Coal/Gas	40%	380	370	1966	2034	2034
Marshall 3	Coal/Gas	50%	658	658	1969	2034	2034
Marshall 4	Coal/Gas	50%	660	660	1970	2034	2034
Belews Creek 1	Coal/Gas	50%	1,110	1,110	1975	2035+	2037
Belews Creek 2	Coal/Gas	50%	1,110	1,110	1975	2035+	2037
Cliffside 6	Coal/Gas	100%	849	844	2012	2035+	2048

Stakeholder Feedback for Coal Retirement Analysis

- General Comments on Coal Retirement Analysis
  - **Magnitude** and **complexity**
  - **Modeling limitations**
  - **Transparency** in results
  - Straight-forward, **standard methodology**
  - Remove **objectivity** from analysis

- Key Considerations for Coal Retirement Analysis
  - **Retirements** should be **considered simultaneously**, timing and order determined by model endogenously
  - Replacement resources should include the option of **multiple resource to fill resource gap**
  - **Retirements** should be **co-optimized with replacement resources**
  - Retirements determined by **net exchange** in investment, maintenance, and operations **cost of the system**
  - Impacts to the transmission system
  - Recognize investment decreases as generating units approach retirement
  - Need for retirement dependency and capturing shifting costs
  - Sunk costs should be excluded, only avoidable costs should be considered

Carbon Plan Coal Retirement Analysis Approach

- Endogenous economic selection of coal retirement in Encompass's capacity expansion model
  - Leverage dynamic cost modeling tool
  - Model determination of order and timing of retirements
  - Co-optimization of retirements and replacement resources
  - Captures net cost differences in investment, maintenance, and operations cost of system
- Still evaluating capabilities of model to handle complexity of analysis
- Option to also evaluate coal retirements in sequential process in detailed production cost model
- Retirements are dependent on replacement resources and may be shifted slightly in execution to support orderly transition of the fleet or to maintain the reliability of the system


Q&A
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Load Forecast Drivers

Brian Bak, Manager, DSM Analytics

Tim Duff, General Manager, Retail Customer and Regulatory Strategy

Matt Kalemba, Director, Distributed Energy Technologies Planning & Forecasting





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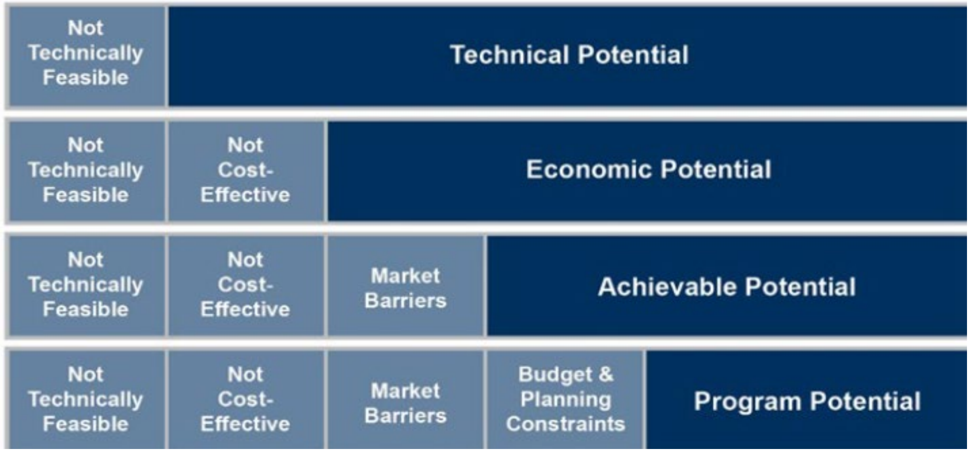
Energy Efficiency (EE) Forecasting

Market Potential Study (MPS)

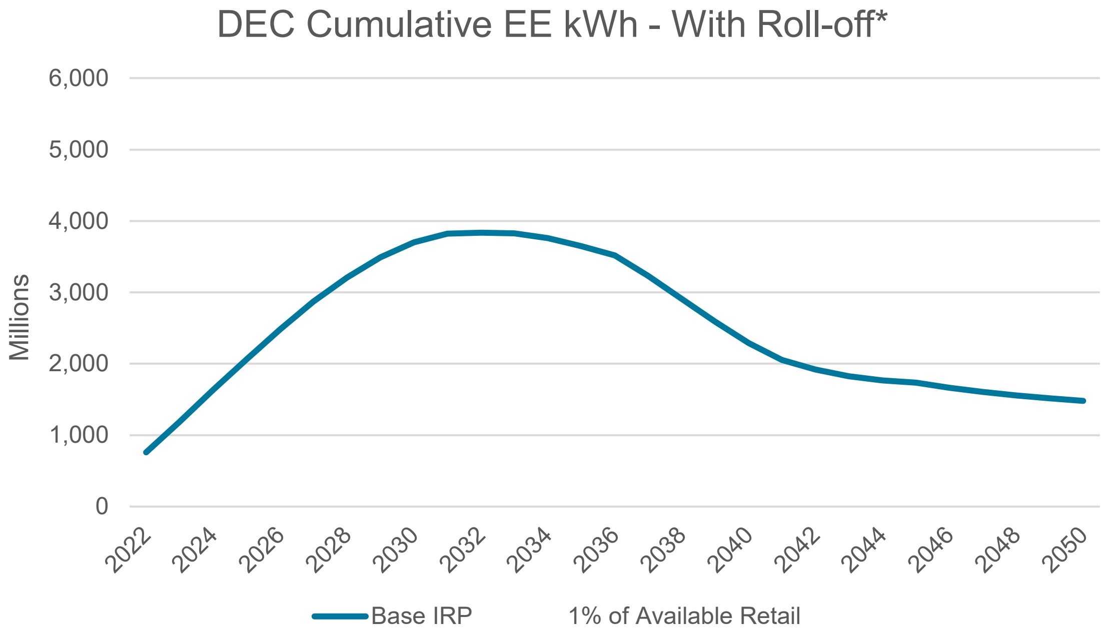
- Performed by third party expert consulting firms
- Used to inform our EE portfolios as well as IRP EE forecasts
- Provide a comprehensive assessment of EE/DSM potential using the best data available at the time to support the study with results specific to the service territory and customer base
- Include all currently known technologies, estimated costs, and energy and demand reduction impacts for these EE and DSM measures

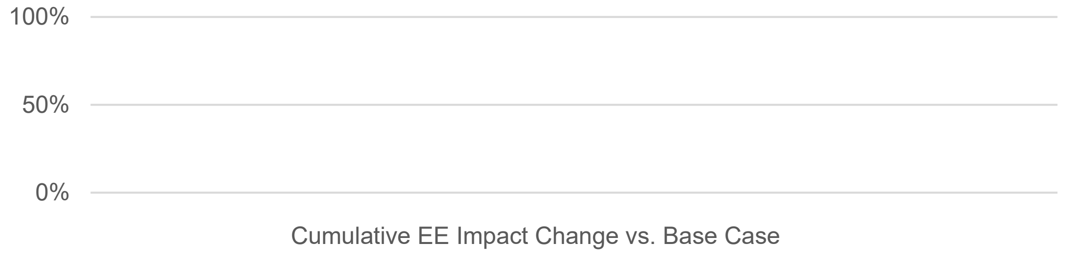
EE Potential Level Estimates

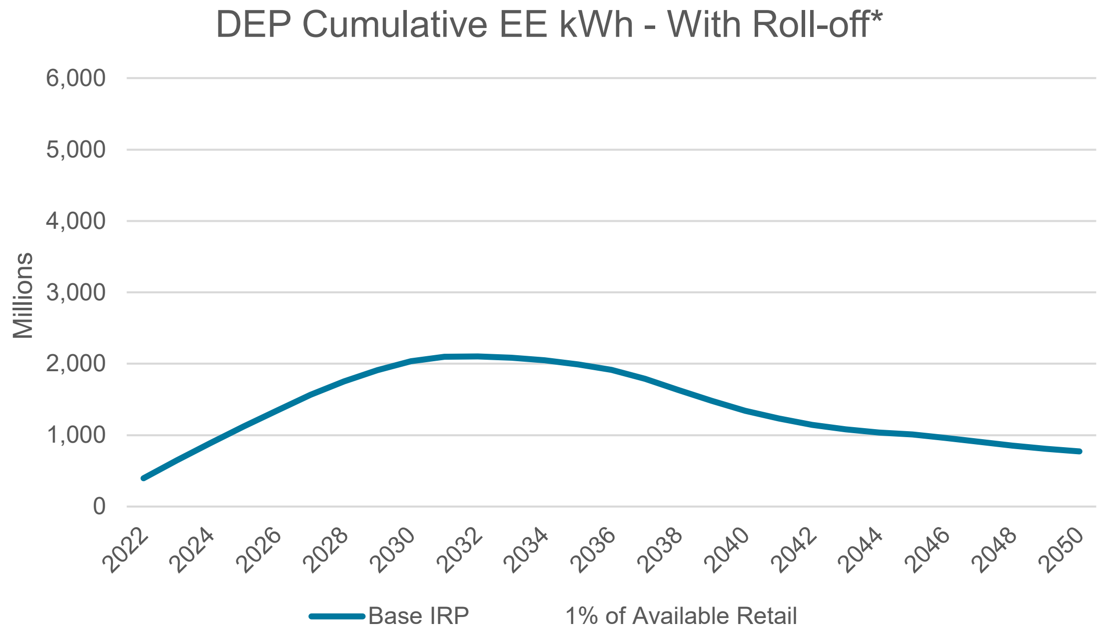
- **Technical** - Maximum savings possible, regardless of cost. <u>Assumes 100% customer adoption</u>
- **Economic** - All cost-effective measures, again with *<u>100% customer adoption</u>*
- **Achievable** - Potential of cost-effective measures based on *<u>realistic customer adoption assumptions</u>*, unlimited program budget and rate rider impact.
- **Program** - Potential of cost-effective measures based on *<u>realistic customer adoption assumptions and reasonable program budgets and rate rider impacts</u>*



Forecast – Base Case



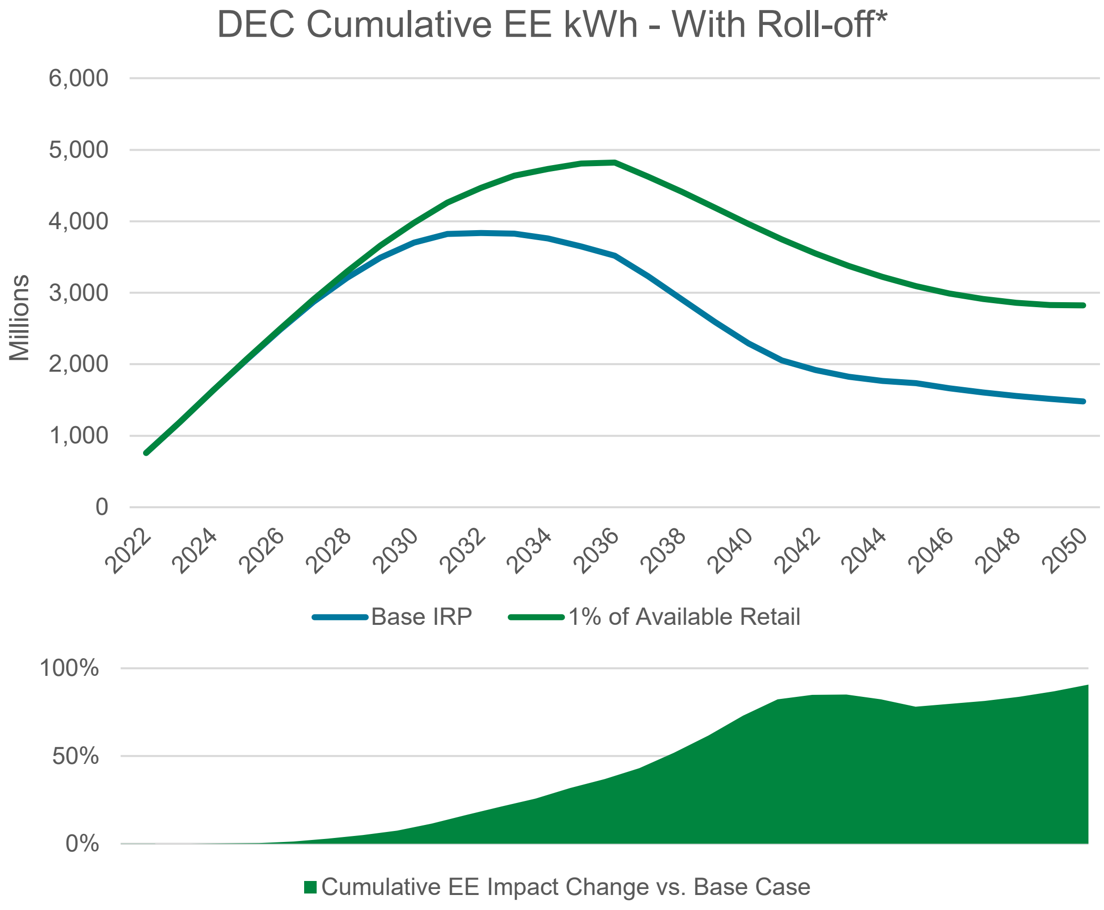


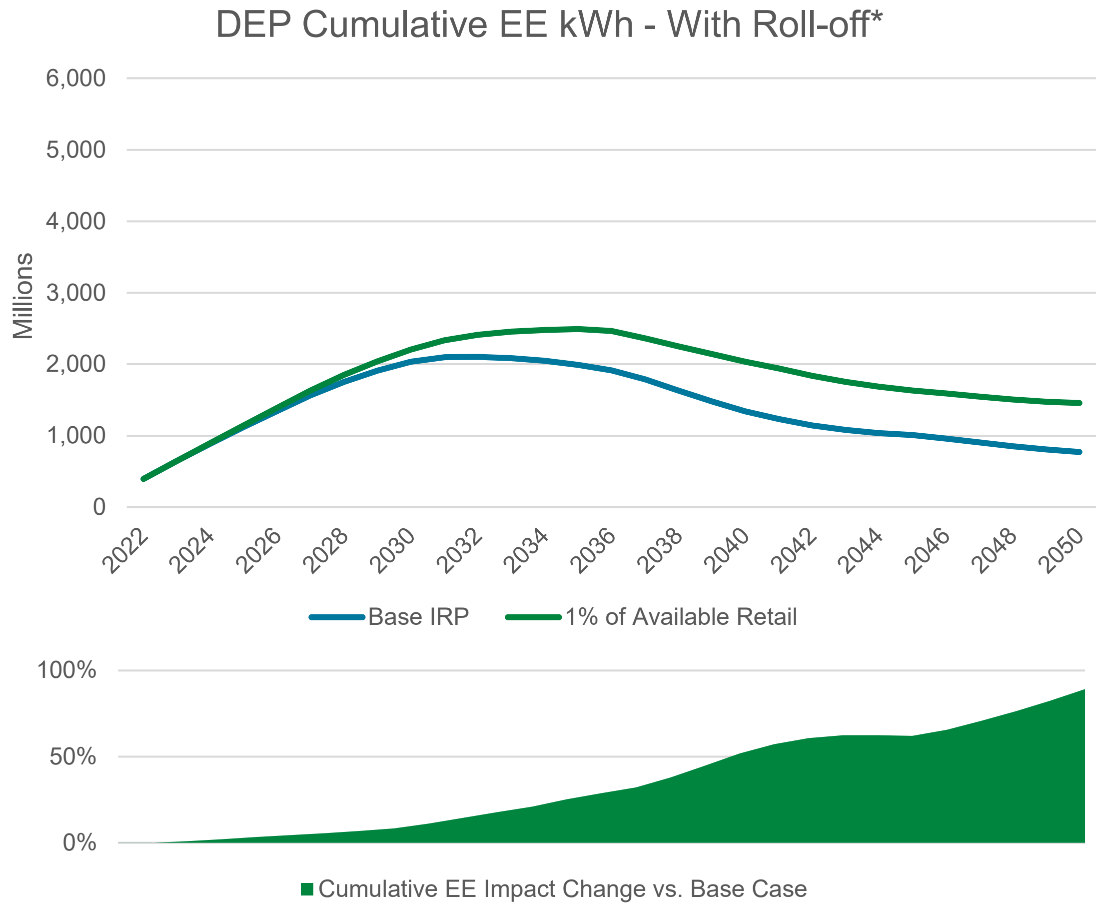


* Roll-off:

- Energy saving impacts no longer represented in our EE forecast as measures reach “end of life”
- Ongoing savings are accounted for in the load forecast.

Forecast – 1% of Available Retail Load





* Roll-off:

- Energy saving impacts no longer represented in our EE forecast as measures reach “end of life”
- Ongoing savings are accounted for in the load forecast.

Moving Beyond the Carolinas' Base EE/DSM Forecast

Program Potential	Budget/ Planning Constraints	Market Barriers	Not Cost Effective	Not Technically Feasible	Program additions and modifications to optimize existing program portfolio impacts
Achievable Potential*		Market Barriers	Not Cost Effective	Not Technically Feasible	Structural modifications and mechanisms that remove market barriers to program participation
Economic Potential			Not Cost Effective	Not Technically Feasible	Modifications that will enhance the cost effectiveness of new programs and enable program modifications
Technical Potential				Not Technically Feasible	Modifications that will expand the number of potential measures and offers reducing consumption from the grid

Potential Enablers for Delivering More EE/DSM in the Carolinas

Structural modifications and mechanisms that remove market barriers to program participation	
On-Tariff Financing	Establishing an on-tariff financing program and the necessary recovery mechanism consistent with HB951 to reduce upfront capital costs and credit barriers to undertaking energy efficiency
Marketing enhancements	AMI and other customer data allows better target marketing of programs to customer with high energy savings potential from specific measures

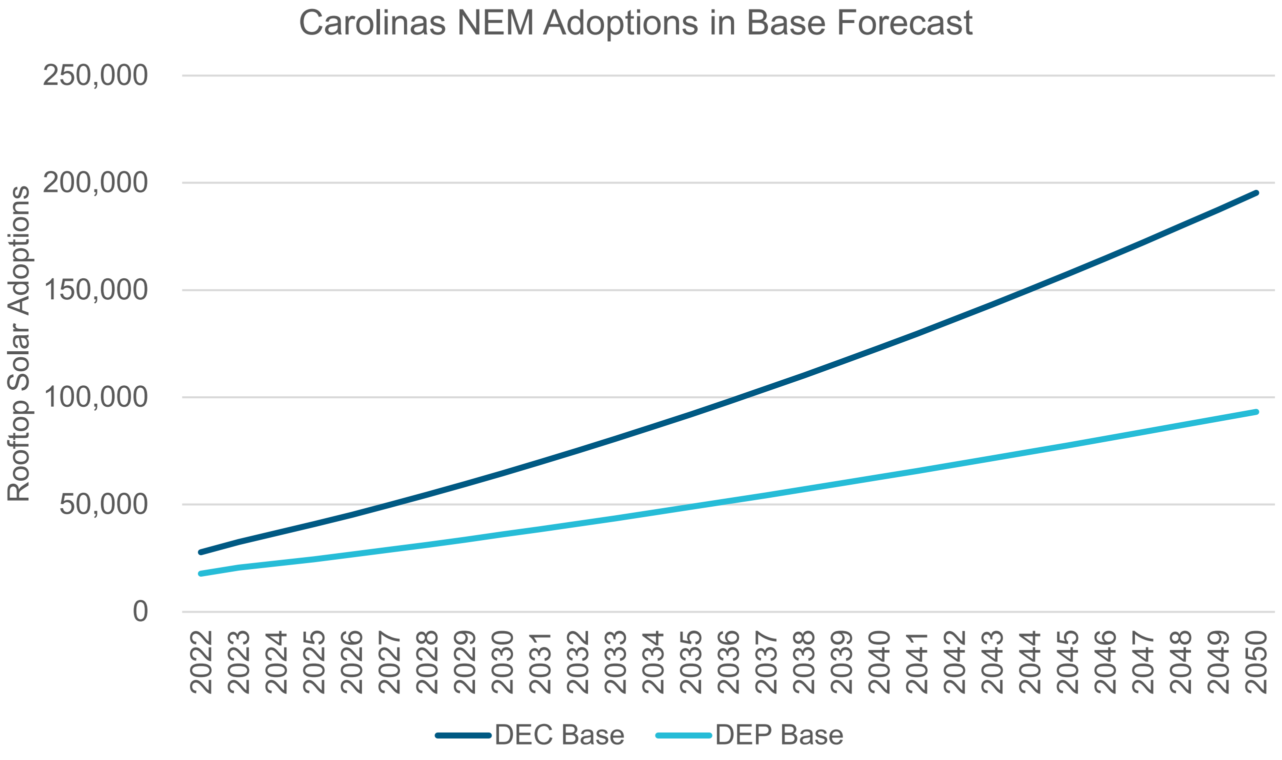
Modifications enhancing the cost effectiveness of new programs and enabling program changes	
Recognition of the value of carbon	A financial value recognizing the value of avoided carbon emissions from energy efficiency programs in cost effectiveness evaluation (UCT).
As Found Energy Savings Recognition	Currently energy savings only recognize savings versus a device's efficiency standard despite the fact true carbon reduction is the energy reduction versus the actual device replace
Recognition of localized customer programs values	Identify overloaded circuits/substations and target localized customer programs to offset specific required high T&D spend

Modifications expanding the potential measures and offers reducing consumption from the grid	
Utility Codes and Standards Program	Currently advancement of building codes and appliance standards reduces potential savings. Creating opportunity for attribution associated with code advancement and compliance
Customer owned assets that reduce grid consumption	Opportunity to incentivize customers to adopt assets like rooftop solar that reduce energy consumption and carbon emissions from the utility grid.not currently shown as potential
Development of energy efficiency programs for new electrification loads	Currently electrification adds load to the forecast, but little to no energy efficiency opportunities associated with load that actually reduces non-utility carbon emissions
Modifications to Non-Residential Customer Opt Out	Currently energy and carbon savings associated with efficiency potential for industrial and customers using over 1,000,000 KWH not able to be achieved through utility programs
Expand EE Programs to wholesale customers	Opportunity to expand potential EE savings and carbon savings to include potential from customers that take generation from the Duke Carolinas' system.

Carolinas Net Metered (NEM) Solar Forecast

NEM Projections

- Base Case projections use currently approved tariffs in North Carolina and South Carolina
- Other suggested NEM Projections?
  - Aggressive price declines
  - 30% ITC
  - **Other options?**



Jurisdiction	Base NEM as % of Total System Energy
2023	
Duke Energy Carolinas	0.5%
Duke Energy Progress	0.6%
2025	
Duke Energy Carolinas	0.6%
Duke Energy Progress	0.7%
2030	
Duke Energy Carolinas	0.9%
Duke Energy Progress	1.0%

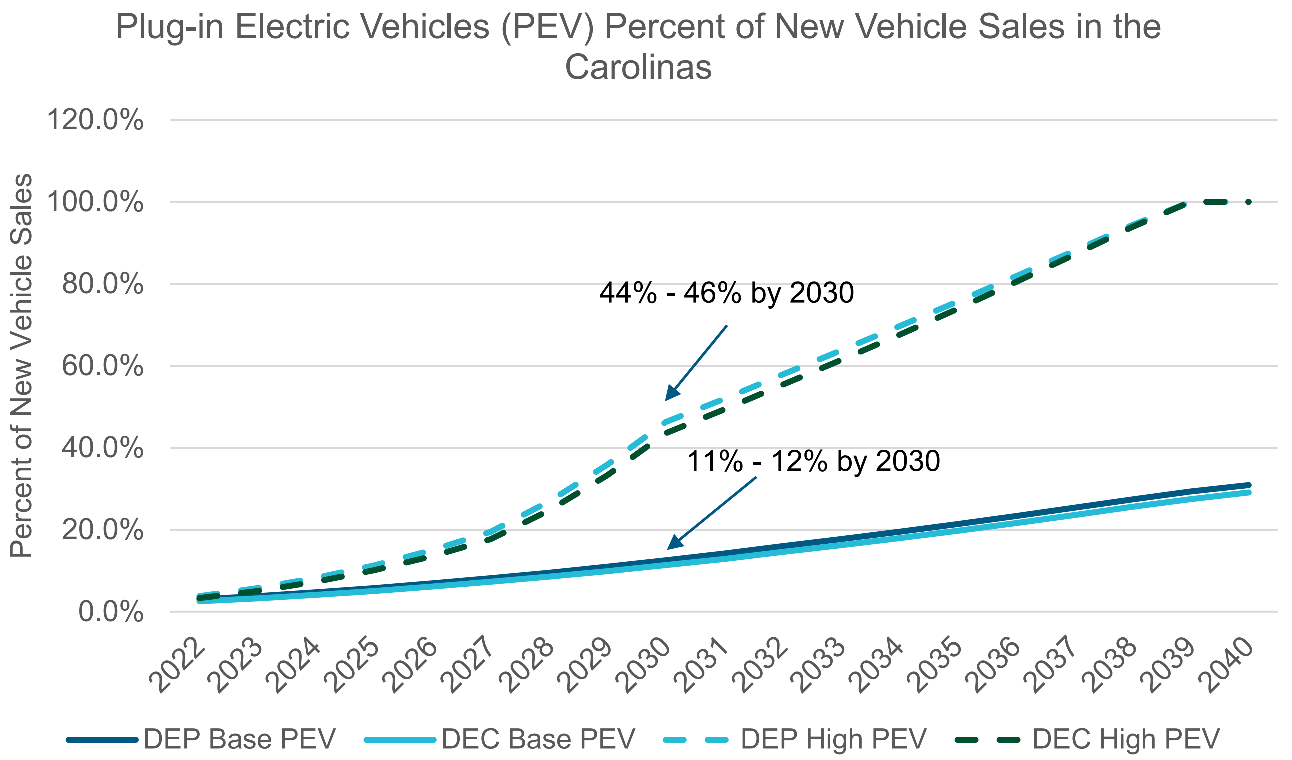
Electric Vehicle Adoption Assumptions for the Carolinas

Base EV Projections

- Base projections based on mid-2021 data shows continued steady adoption of EVs across the Carolinas
- Includes projections for light duty (LD), medium duty (MD), and heavy duty (HD) EV adoption

Alternative Projections

- Updated Base Scenario accounting for increased commitments from EV manufacturers and accelerated adoption in 2021
- High Case: Achieve President Biden's goal of PEVs making up 40% - 50% new vehicle sales by 2030
- **Other suggested forecasts?**



Jurisdiction	Base EV Energy - % of Total Energy	High EV Energy - % of Total Energy
2023		
Duke Energy Carolinas	0.1%	0.1%
Duke Energy Progress	0.1%	0.1%
2025		
Duke Energy Carolinas	0.2%	0.4%
Duke Energy Progress	0.3%	0.5%
2030		
Duke Energy Carolinas	1.4%	3.2%
Duke Energy Progress	1.6%	3.9%

Q&A

Break

Please return at 3:05PM.

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Solar Interconnection Forecast

Matt Kalemba, Director, Distributed Energy Technologies Planning & Forecasting





JANUARY 24, 2022

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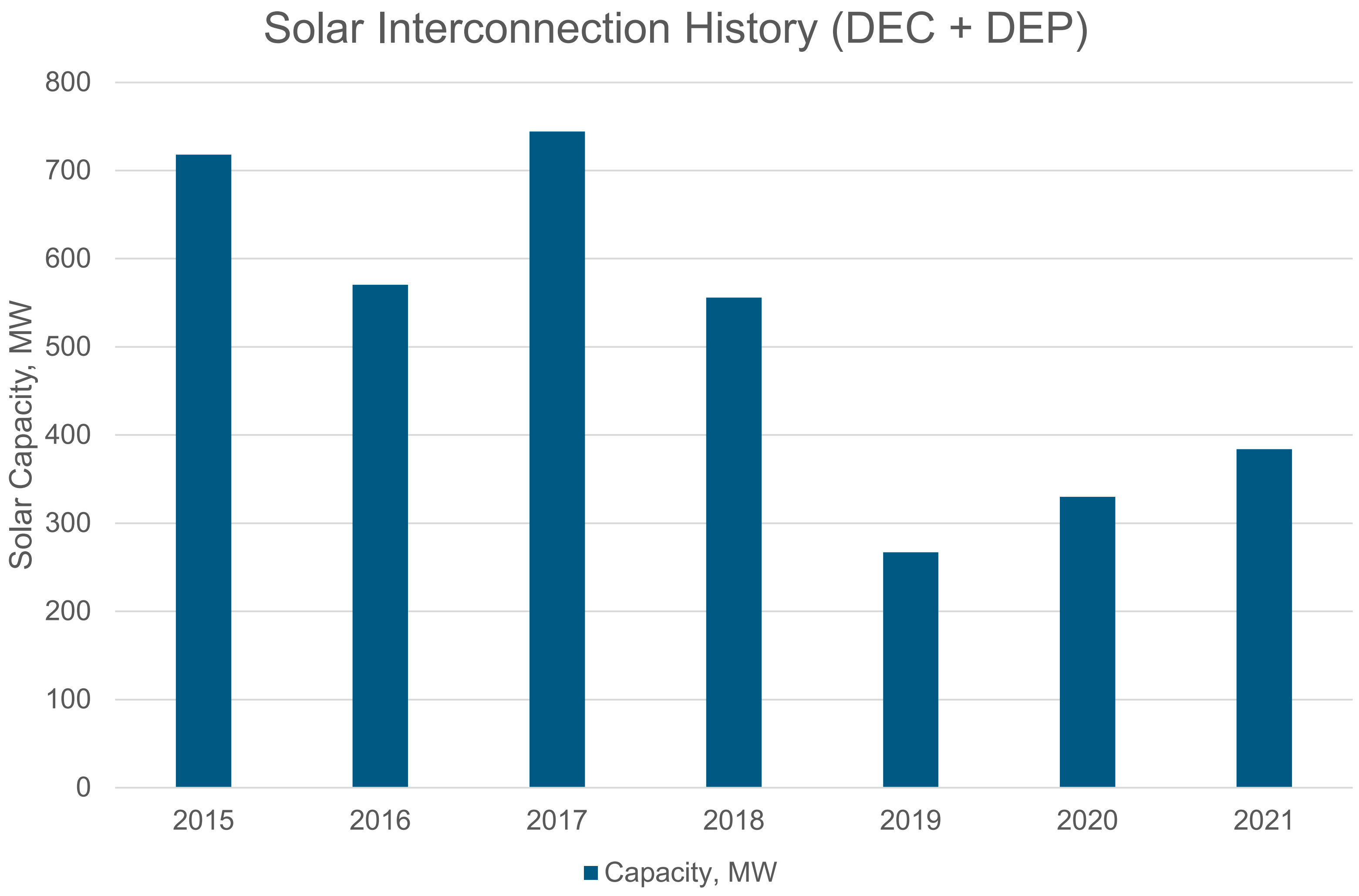
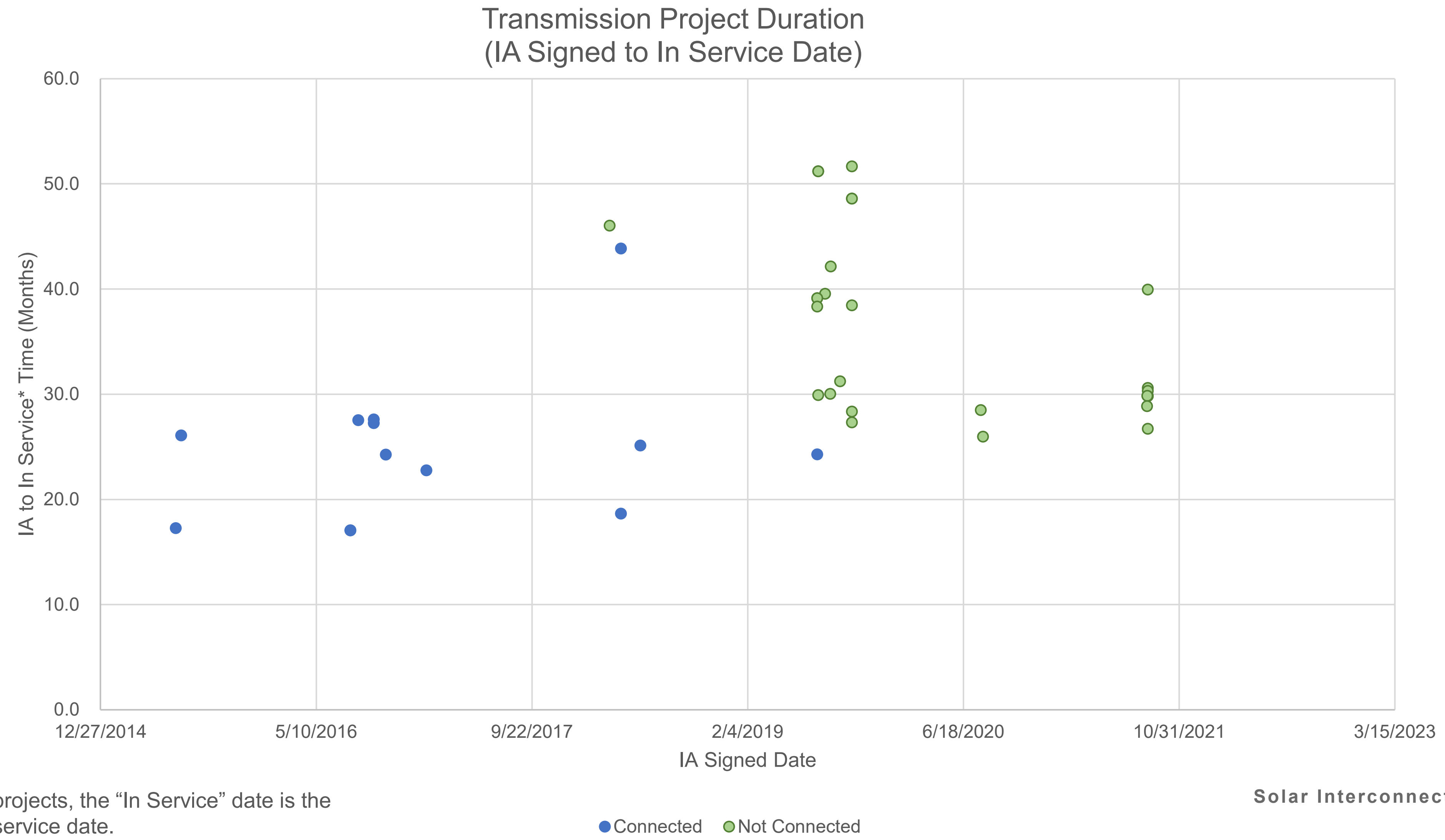
Annual Solar Interconnection Capability - History

- Average about 510 MW/year of solar interconnections since 2015
- Average approximately 9 transmission interconnections annually



Annual Solar Interconnection Capability – Time to Interconnect Trends



*For "Not Connected" projects, the "In Service" date is the currently estimated in service date.

Annual Solar Interconnection Capability – Model Sensitivities

- Land availability, supply chain, increasing transmission reliability and resiliency upgrades, and other resource additions / retirements are headwinds to increasing annual solar interconnections
- Shift from smaller, distribution tied solar to larger transmission projects may increase efficiency
- No regrets, proactive strategic transmission investments would enable shorter interconnection timelines

Range of Interconnection Capability Sensitivities

(Annual Nameplate MW Interconnections)

	2026	2027	2028	2029	2030	Potential Connected Solar by 2030
Transmission Constrained	*up to* 500	500	400	400	400	~9,400
Progressive	*up to* 750	750	750	750	750	~11,000
Enhanced Transmission Policy	*To Be Determined*					*TBD*

- *Transmission Constrained* – Decreasing land availability in unconstrained transmission areas increasingly restricts growth opportunities
- *Progressive* – Land availability less constraining than expected, cluster study process leads to more efficient interconnections as upgrade costs are shared among more participants, and / or shift to larger solar facilities leads to steady solar interconnections at historically high levels
- *Enhanced Transmission Policy* – Proactive strategic transmission investments lead to more efficient solar interconnections and increased possibility of larger solar projects

Technology Forecast

Adam Reichenbach, Generation Technology, Lead Engineer

JANUARY 25, 2022

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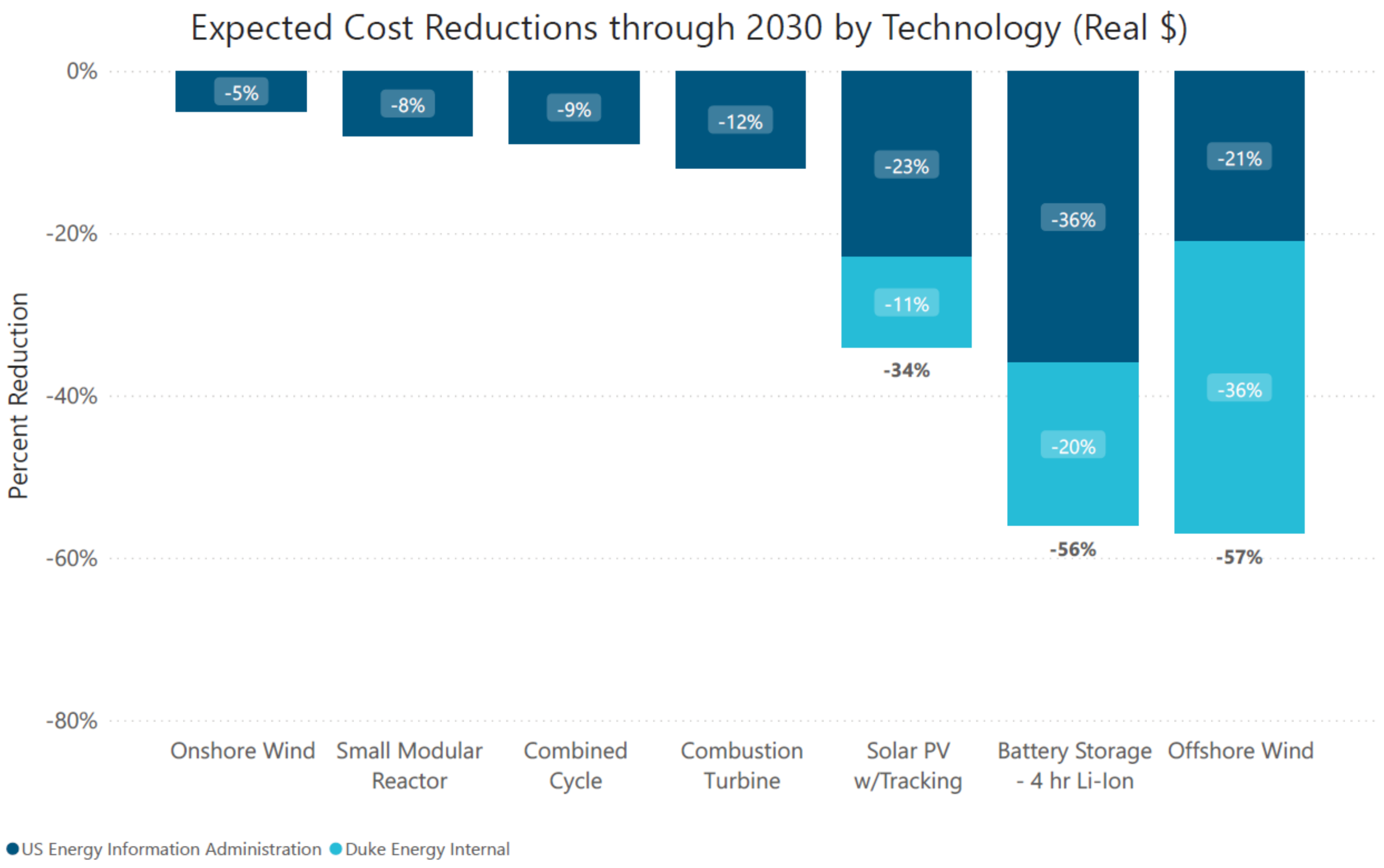
Technology Information

Technology[1]	Role	Dispatchability	Annual Capacity Factor
Solar PV with Tracking	Variable	Partial	25-30%
Offshore Wind	Variable	Partial	40-45%
Onshore Wind	Variable	Partial	20-30%
Battery Storage	Storage/Peaking	Full	15-25%
Pumped Hydro Storage[2]	Intermediate	Full	25-35%
Advanced Nuclear	Baseload	Partial/Full	60-95%
Combined Cycle[3]	Baseload	Full	40-80%
Combustion Turbine[3]	Peaking	Full	< 25%

Note 1: Sources of data for Duke modeling are Burns & McDonnell, Guidehouse, and EPRI.
Note 2: Pumped Hydro Storage has both pumping and generating capabilities.
Note 3: Hydrogen is under consideration as an emergent fuel source.

- This table represents existing technologies or near-term emerging technologies that we believe will be available within the planning horizon.
- Duke's Emerging Technology Assessment Team (ETAT) is actively looking at other potential energy solutions

Technology Learning Curves



Natural Gas Price Forecast

Bobby McMurry, Director, Production Cost Modeling & Analytics

JANUARY 25, 2022

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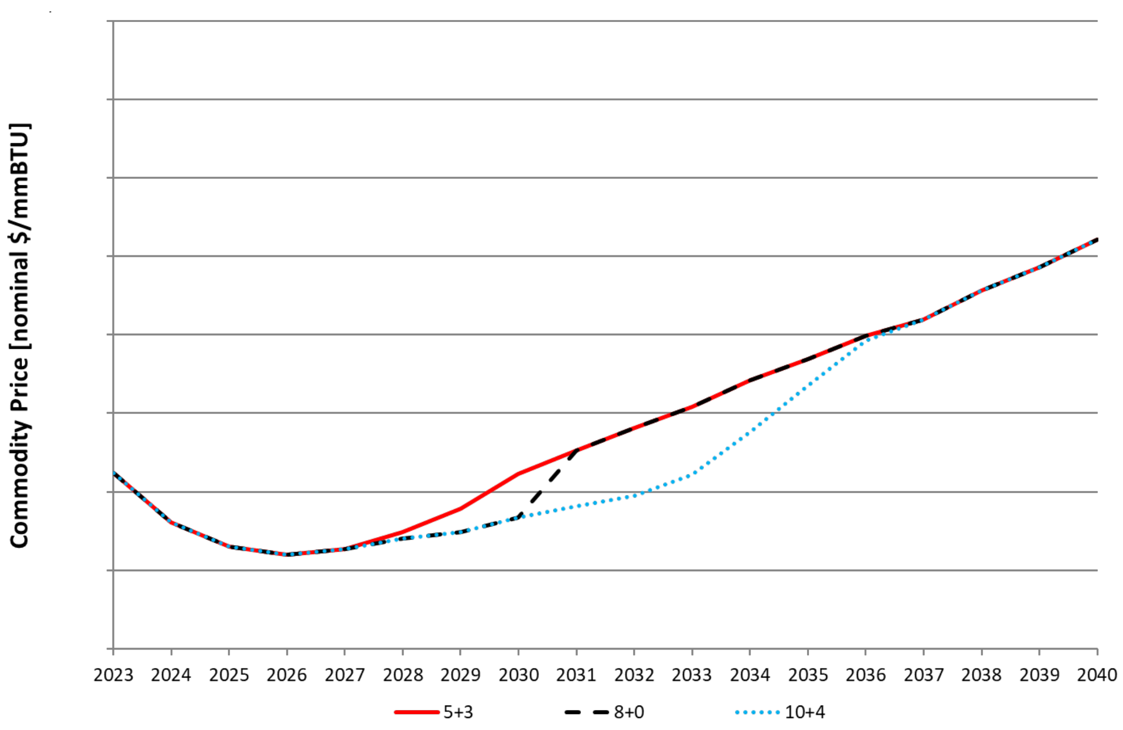
Natural Gas Forecasting Methodology

- Historically
  - Use of 10 years of market gas with 5 years blend to 100% fundamentals
  - Fundamentals - Provided by IHS biannually
  - Avoided Cost (NC) – Use of 8 years Market and 100% fundamentals year 9.

- Proposed Change of Methodology
  - Use of 5 years of market gas w/ 3 year blend to fundamentals
    - Coal and gas on the same blending basis
  - Fundamentals – Use an average of EIA, EVA, IHS and Wood MacKenzie.
    - Decrease volatility in fundamental fuel price from one year to another.



Q&A

Next steps:

- Information/feedback can be sent to DukeCarbonPlan@gpisd.net
- The next meeting will take place on Wednesday, February 23rd. GPI will be sending out an email later this week with the link to register.

Meeting materials/recordings will be uploaded to the website:

www.duke-energy.com/CarolinasCarbonPlan

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